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Psychological Bulletin

HABITUATORY RESPONSE DECREMENT IN THE INTACT ORGANISM[1]

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I. Introduction

Perhaps the most ubiquitous phenomenon in animal behavior is that of response decrement as the result of repeated stimulation. For all animal forms, practically every stimulus-response relationship is subject to one or more types of decremental modification in consequence of continued stimulatory activation. It is impossible to overestimate the importance of this general fact for the definition of the precise conditions under which certain bits of behavior will or will not appear; yet with few notable exceptions —and these principally in the field of learning—psychologists concerned with the formulation of general behavior schemata have preoccupied themselves with positive aspects of reaction to the partial exclusion of the almost equally important reciprocal, or negative aspects.

The present paper emphasizes one of these negative aspects of behavior variously called "negative adaptation," "acclimatization," "extinction," "inhibition," "accommodation," "stimulatory inactivation," and "habituation," as well as other less widely used terms. Exactly what is meant by the common denominator of these generic terms cannot precisely be defined; but what is referred to are all those instances of decrement in magnitude of unlearned responses (1) which occur centrally in the intact organism, (2) which are due to repetitive stimulatory activation, and (3) which may, on the basis of criteria discussed later, be distinguished from other types of response decrement occurring as a result of, for example, receptor adaptation, loss of the effector's ability to respond, or any of the various types of inhibition.

While none of the terms cited is especially appropriate to this type of response decrement, we shall use the term "habituation" throughout. Little can be said in favor of this term except that all the others imply an

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explanation which is unjustified by the facts, or have been used extensively in a wider variety of ways, or have some more valid use in another connection. Perhaps the most commonly applied term, negative adaptation, seems to deny that response decrement may be an active process. Habituation, on the other hand, has in its favor that it is not ordinarily applied to other types of behavior, implies the knowledge of no specific or general mechanism underlying the phenomenon (of which we are as yet in almost total ignorance), and in addition has been freely used in referring to exactly the type of behavior modification of which we speak.

This paper was undertaken upon several considerations: first, that no critical study which can be considered adequate has yet appeared reviewing habituatory response decrement over the whole range of phyla; and secondly, that the little-understood concept of habituation is being increasingly recognized as important in the analysis of learning, more particularly of conditioning (**49**, **50**, **66**, **101**, **102**).

Of the large number of references in the literature to instances of habituatory response decrement, a great many will be found as incidental notes in papers upon quite different topics. These observations-by-the-way have almost no value for a critical review, since systematic data ordinarily either have not been gathered or have not been reported so that the reader can make his own analysis. No attempt is here made to exhaust such references. There is, however, a large enough selection of papers concerned more or less specifically with habituatory phenomena so that a good number of comparisons and conclusions can be drawn; within this representation the present review claims to be rather comprehensive.

II. General Considerations

A careful analysis of the successive events in a typical response reveals quite a surprising number of significant variables. Rosenblueth (**105**), for example, lists eight events occurring in succession from the activation of a motoneuron to the final contraction of its muscle. It is probable that even in the simplest arc, containing only one or two internuncial neurons, no less than 16 or 20 separable processes occur; in the more complex stimulus-response relationships a great many more are certainly involved. Now, it is known that every one of these processes is subject to decrements of one sort or another, and further that each decrement may affect response magnitude under appropriate stimulatory conditions. But an even more bewildering set of facts appears: a number of these processes are modified in radical ways when other stimulus-

response relationships are active in the organism at about the same time, and these modifications often take the form of response decrement.

Although it is generally admitted that with any habituatory process there occur simultaneously other types of decremental processes directly affecting the same response and referable to identical activating stimuli, there is nevertheless no cause for despair. For laying out the field of habituation and for distinguishing it from closely related fields, it is fortunately true that all forms of response decrement to repeated stimulation are functions of *time*. It is primarily due to this fact that in order to discriminate types of decrement one may in most experimental situations appeal to certain qualitative and quantitative characteristics of a *series* of stimuli to which the appearance and disappearance of a particular response may be referred. For example, it is primarily by the temporal characteristics of the series of stimuli used that one may distinguish decrement of response due to receptor changes from decrement due to refractory characteristics of nerve.

One may thus with quick strokes separate types of response decrement according as they appear at particular frequencies of stimulation. When this is done it is found that certain stimulus-response integrations, activated at intervals long enough to preclude loss of ability of either receptor, conductor, or effector to respond maximally, will still decrement to zero level. To such decrement, uncomplicated by interaction with other integrations, we apply the term habituation.

In other cases, it is true, the term is applied with considerably less confidence. Granting, let us say, that habituation and fatigue in a broad sense exist as justifiably separated categories, one is often at a loss to distinguish the effects of the two processes upon a particular response. A close inspection of the term fatigue reveals, indeed, a state hardly less confused than that of habituation. Yet there is no doubt that, where the two can be distinguished, it is incumbent on the experimenter to tease out the separate effects; and further, it is certain that until this has been done no psychologizing can be attempted, *i.e.*, the constants of the mathematical relation between stimuli and response cannot be derived.

Fortunately, also, habituation may be studied as a function of variables other than the temporal characteristics of the series of stimuli in question: it is found to vary with strength of stimulus, with sense modality, with response, and with species. These and other variables hereafter described are of considerable value both in distinguishing instances of habituation and in furnishing hints

as to the fundamental conditions underlying the behavior in question.

It will be obvious, when once we have reviewed the facts of habituation from *Protista* to man, that no "mechanism" of habituation will be found. There are quite probably several mechanisms; we know, at least, that habituatory phenomena can be observed throughout so extreme a range of organisms and under such widely varied experimental conditions that any single explanatory principle would have to be too general to be satisfactory. Such an explanation as a typical neurological one, that habituation is due to changes in the properties of synapses (**99**), probably cannot apply in those organisms possessing a syncytium—and certainly not in the protozoa. Moreover, even for those animals possessing true internuncial synapses this explanation does nothing more than roughly to suggest the locus of the phenomenon. We may expect to find certain conditions in the nervous system suggested as the basis for an explanation of habituation. At the moment, however, neurophysiology offers the student of habituation very little.

Accounts of habituatory phenomena as illustrative of some all-inclusive biological dictum are more unsatisfactory, and for more fundamental reasons. Explanation in terms of re-establishment of equilibrium (**59**), for example, must be rejected as insufficient. It is true that all animals are continuously and actively readjusting to energy shifts in the environment, and that new balances of all sorts are being struck; but it is apparent that such statements can be only grossly descriptive—an appeal simply to the sapience of nature will hardly suffice the careful student.

In view of our lack of the slightest knowledge as to the neurophysiological mechanisms of habituation, the most convincing type of explanation would seem to consist in stating the precise conditions over wide ranges of organism and of stimulation under which habituation will and will not appear. An analysis and summary of these conditions may then lead to more important generalizations than we command at the moment.

III. Review of Experiments

Phylum: Protista

It is sometimes stated that response decrement to repetitive stimulation in the case of the unicellular animals can only be due to a loss of receptivity. In certain cases such a crude form of

"sensory adaptation" may account for response decrement, but in other instances it can be shown that a particular response may drop out while unquestionably the stimulus is not without further effect on the organism. In any case, the temporal sequence of stimuli and the corresponding changes in protistan behavior often bear such close similarity to the phenomenon of habituation as the latter is typically exhibited in the metazoa, that it seems best to review the material on unicellular forms, with appropriate reservations in some instances as to the nature of the phenomenon.

Class: Rhizopoda. It is a universal observation that a great number of stimuli will cause Ameba to cease protoplasmic streaming, and that, if the stimulus is continuous and not too intense, the streaming will shortly begin anew. Such general statements have been made by Buytendijk (11) and by Jennings (62) for mechanical and chemical stimuli. The latter author states, "Ameba react negatively to tap water or to water from any foreign culture, but after transference to such water they behave normally." Mast reports similar behavior in the case of light, new pseudopods being formed "after a few minutes exposure." This effect apparently may be local in character if the stimulus is applied to a restricted area. (69)

The best evidence on habituation in Ameba is furnished by Folger, who studied it as a function of type and intensity of stimulus, of previous amount of exposure to light, and of individual differences. In his investigation of the effects of mechanical shock on locomotion in *Ameba proteus* (36), Folger placed individual specimens on a glass slide provided with a cover slip. A thin tube 68 cm. long was placed vertically on the middle region of this preparation and wires of weights varying from 58—428 mg. were dropped through the tube onto the slide. These weights furnished mechanical shocks of just below threshold for the middle animals and ranged upwards. The experimenter noted the length of time elapsing between cessation and resumption of movement. An indication of direct proportionality between the shock intensity and the duration of quiescence was obtained.

In another experiment Folger (35) studied the effects of light increase upon the same response. *Ameba proteus* and *A. discoides* were used interchangeably. In view of the supposition that in Ameba the retaining of ability to respond to light is explainable purely in photochemical terms, Folger was interested in the conditions of light and dark under which maximum reactions would occur to an increase in intensity of illumination. He presents evidence that Ameba becomes maximally responsive to light (i.e., exhibits shortest reaction-times) after 15 to 20 seconds in the dark; but by varying the duration of the light between 5 and 120 seconds *preceding* a 10-second dark-adaptation period before the test light was flashed on, Folger showed that a certain degree of recovery could take place in the dark. We cannot follow him in his conclusion that since recovery may partially occur in the light, no reversible photochemical reaction is present. However, with his statement that recovery from shock in Ameba is a complicated process we can well agree. It is probably accurate to assume that there are at least two sets of processes involved, one a true

dark adaptation and the other or others unknown. Folger is of the opinion that one of these latter occurs with equal rapidity in light and in darkness, usually occupying an extended time—one to two minutes.

The observation (Folger, **37**) that the effects of mechanical and photic stimuli are indistinguishable is of great importance in this connection. Mast (**70**) concluded that an Ameba's resumption of movement to a strong continuous light was underlaid by a process of solation taking place after sudden illumination had gelated the protoplasm. If this is true it may throw some light on the nature of mechanical stimulation. Folger demonstrated (**35**) that not only is one unable to tell from the nature of the response what has stimulated Amebae, but also that mechanical shock and photic stimuli are related in such a manner that, after cessation of movement as the result of light increase, a certain interval must elapse before the animal will respond to mechanical shock, and vice versa. Of course there is here no indication that the two processes are identical —there is only an intimation of similarity.

Class: Infusoria

Subclass: Ciliata. Without citing extended experiments indicating the ability of *Paramecium caudatum* to differentiate types of stimulus, Jennings (**62**) states that this animal has one major reaction for all stimuli to which it is responsive at all: a simple avoidance response. So true is this that Jennings feels himself able to make the generalization that the *effective* stimulus for reaction is *any* supraliminal change of energy in the environment. A consequence of this statement is that Paramecium will after some interval of time cease reacting to an energy pattern which ceases to change—and this is, in fact, just what is reported. To continuous stimulation of any sort the paramecium, it is said, "soon becomes acclimatized." This will be true, according to Jennings, for mechanical, chemical, thermal, photic, and electrical stimulation, and for stimulation by gravity or by certain internal stresses.

One important modification of this statement must be made: habituation does not occur if the extent of the environmental change is so very intense that is is likely to become immediately lethal. Thus, paramecia dropped into almost any highly injurious chemical solution will dash about till necrosed. Again, while these organisms may be kept in water slowly heated to 36–38° C, yet if dropped of a sudden into water of 37° C, neither habituation nor acclimatization occur appreciably and the animals die.

Subclass: Tentaculifera. A non-experimental reference to habituation in Stentor is found in Davenport (**18**) who quotes a friend to the effect that in a colony these creatures were seen not to contract when struck repeatedly by Tubifex worms waving back and forth in the same aquarium. That Stentor will usually contract quite readily to similar contacts if these are spaced sufficiently far apart is commonly known by all who have observed these graceful animalcules. Jennings reports that it occurs very quickly. In describing decrement of responses after the first given to mechanical stimuli, this author believes himself to have ruled out fatigue in the sense of "exhaustion" by noting that, while habituation to mechanical stimuli appears promptly, nothing of the sort appears to repeated food stimuli (**63**). In addition, he observes that habituation occurs most

readily to ***weak*** stimuli, whereas, if fatigue were the explanation, the more violent contractures occasioned by the more intense stimuli should produce the greatest decrement. As a further check still (**60**), he forced *Stentor roeselii* to contract steadily for an hour by stimulating with M/150 NaCl. Jennings' logic seems rigorous enough.

In the latter study also, Jennings denies "sensory" adaptation a major role in the disappearance of protistan response. *Stentor coeruleus*, Epistylis, and Vorticella, though no longer contracting in the usual manner when touched by a glass rod, yet were responding quite definitely to it by swaying, bending, etc. It is more difficult to weigh this evidence than in the case of fatigue. Complicating factors here present include the possibility of reduced local sensitivity combined with summation of stimulus effects at more distant points on the animal, and the like. It is not possible to exclude a prototype of sensory adaptation as an important factor in this case.

In the main series of these experiments Jennings struck the infusoria with a fine glass rod or a hair, roughly equating the force of the blows. All organisms contract on the first stroke irrespective of the stimulus intensity. This contraction lasts one minute or less, whereupon the animal slowly expands. If, as soon as extension is complete, another stroke be given, and this procedure be repeated indefinitely, response decrement will proceed in the direction of (1) more and more taps being necessary for a single contraction, and (2) slower extension. The following is a typical record of *Stentor coeruleus*, where the dashes indicate a contraction and the figures the number of taps necessary for one contraction to occur: 1-1-1-1-1-1-1-2-2-1-2-1-2-1-2-3-1-1-1-1-1-2-6-10-1-2-9-13-3-14-7-3-2-3-3-9-18 (here Stentor pulled loose from the substrate and moved on.) Similar results were obtained with *Stentor roeselii* Ehr., Vorticella, Epistylis, and Carchesium, except that these species never broke loose. A typical record for *Epistylis flavicans* was as follows: 1-1-1-1-1-1-1-2-33-25-7-13-36-20-14-13-13-33-9-30-3-31-226.

As a consequence of these and similar results, Jennings concludes that under certain conditions protistan behavior exhibits a type of response decrement not referable to factors of external receptivity or exhaustion, and similar in many ways to that of higher forms. He does not feel able to say anything of what the phenomenon fundamentally exists other than that the difference is "in the physiological condition of the organism before and after the stimulus" (p. 51).

A somewhat more precise control of stimulus intensity of mechanical shock with *Vorticella nebulifera* was effected by Danisch (**17**), passing over a pulley a string with a constant weight tied to one end, the other end to support a series of lighter weights falling a certain distance onto the substratum of the subjects. He corroborated the findings of Jennings that weaker stimuli are followed by quicker habituation, and adds these figures: stroke of 500 ergs followed by habituation after 9 applications; of 1000 ergs, after 15 applications; of 1500 ergs, after 40 applications; and of 2000 ergs, not after 420 applications. It is to be understood that one must regard this attempt at quantification as extremely tentative in view of the wide individual variations reported in this as well as other situations, and in view of the many technical difficulties involved.

The failure of this response to habituate to a strong stimulus in any reasonable time will be alluded to again. It will only be pointed out here that there is no indication that the most intense stimulus used by Danisch was in any sense "harmful."

Summary of Protista. The repertoire of responses to all external stimulation of Ameba and Paramecium is extremely limited, consisting of a so-called "shock-reaction," cessation of protoplasmic streaming in the former, and reversal of ciliary beat in the latter. This shock-reaction, to all but intense stimuli, will decrement in duration and extent for both animals. It is not determined whether the nature of this decrement is based on receptive factors, exhaustion factors, or other unknown internal factors; at least one important author believes the latter. Characteristic features include a nonappearance of the phenomenon to intense stimuli and a direct proportionality within limits between degree of habituation and intensity of stimuli. In the fixed infusoria, if complete extension of the tentacles be allowed after each of a series of contractions, habituation will be evidenced by an increase in number of taps necessary to cause a single contraction, and also by slower re-expansion after successive contractions.

Phylum: Coelenterata

This phylum, a step higher than Porifera (in which habituation has never been studied systematically), exhibits in its higher species several very important biological advantages over protozoa. Thus, even in Coelenterata we have the morphological requirements for behavior which, compared with Protista, is relatively complicated.

Class: Hydrozoa. Only very slight differences exist between the characteristics of habituation as found in protozoa and in the simple hydrozoa. That it occurs readily is attested by Wolff (**122**) for colony-dwelling species. Possible transfer effects within the colony are not mentioned. It was found by Goldsmith (41) that not only tapping the animal but even a slight tap on the substratum to which the animal is attached will cause a complete contraction which in a minute or less will be followed by extension. He noted that if one waited until extension was complete before tapping again, no evidence of habituation would be forthcoming. If strokes were given at shorter intervals, contraction would remain complete for a period, until finally—even though the taps were being continued—expansion of the tentacular ring occurred. A stronger intensity of stimulation would, however, reinstate contraction temporarily.

Goldsmith's observation that no habituation occurred if complete expansion be allowed is confirmed by Wagner (**113**), who found no change in readiness of contraction or in rapidity of subsequent re-expansion after

a series of 50 stimuli. In addition, this author more carefully defined the conditions of habituation. He showed that tapping the microscope stage at half-second intervals caused *Hydra viridis* to maintain contraction for thirty seconds to one minute, after which expansion took place and the taps were ineffective unless increased sharply in intensity. This was also true for touching the tentacles with a fine glass rod at intervals of a half-second or a full second.

According to Wagner, certain Hydra are much more active than others in habituating, although somewhat similar results are obtained from all species. *Hydra viridis* appears the most satisfactory form with which to work, *Hydra grisea* and *H. fusca* particularly being sluggish and irregular in reacting.

Class: Scyphozoa. Scattered references to habituation in the larger jelly-fish are contained in Romanes' classic work (**104**). He frequently remarks that specimens with which he worked became less responsive. In especial he finds that *Aurelia aurita*, if subjected to the pressures of a stream of water, will shortly show no effects of this continuous stimulation. Unfortunately this gifted physiologist, although encountering examples at every turn, was not directly interested in the problem of response decrement *per se*, and left us little detailed information on that score.

Class: Actinozoa. In the more advanced coelenterates, the sea-anemones, significant improvements appear in behavior modifiability. Of especial importance in this connection is the fact that the length of time during which a stimulus exerts its effect is much greater than in Hydrozoa.

Jennings was among the first to become captivated by these beautiful animals, which are seen when at rest to spread their highly-colored discs near the surface of the water. If a drop of water is let fall on the water just over the disc, a contraction of most of the animal will occur. In Jennings' experiment (**61**) he let single drops fall from a height of 30 cm. He found that the initial drop was invariably reacted to; but if the animal was allowed to expand before each succeeding drop, ordinarily no contraction occurred to the second and third drop, and very rarely to a fourth drop.

This response of *Aiptasia annulata* was then studied as a function of the interval between drops. The interval in the first series had varied around an average of one minute, but Jennings observed that when this interval was held constant at three minutes, rapid habituation was nearly always the case. When the interval was increased to five minutes, considerable evidence of habituation appeared, but with marked "irregularities"; and when the drops fell at intervals longer than five minutes, evidence of habituation was uncertain. Very similar results are contained in a paper of Pieron's (**87**) on mechanical stimulation in *Actinia equina* and *Actinia rubra*.

The increased duration of contraction in a series of stimuli may be cited as another indicator of response decrement in Actinia. When Kinoshita (**64**), for example, repeatedly touched the tentacles of various sea-anemones whenever they became fully extended, he found the duration of contraction to become shorter and shorter. It will be recalled that

under similar conditions *Hydra viridis* showed no variation in duration of contracture. A distinct interspecies difference is apparent in Kinoshita's data, in that some species took much longer than others to extend after the initial stimulus, but it is significant that all specimens reached a comparable level of habituation in close to the same number of trials.

Nagel (**76**) demonstrated that both Adamsia and Metridium, when pieces of meat and of filter paper were fed alternately, continue to accept the food and refuse the paper. Exactly of what this refusal consists has been the topic of nearly a dozen papers. There is some slight evidence that something like habituation underlies the phenomenon, and the controversy will be briefly reviewed.

Nagel showed (**79**) that soaking filter paper in fish juice and placing it on the tentacles of Adamsia resulted in behavior similar to that for fish meat; but that after several repetitions the ball of paper was rejected. It was remarked that on each successive repetition Adamsia held the paper a shorter and shorter time before rejecting it at once. He also discovered that in this situation the neighboring tentacles, never offered the paper, were not affected. This "dummy feeding" experiment was immediately repeated by Parker (**82**) and confirmed in detail for Metridium.

Jennings, in his major study on the sea-anemone (**61**), followed a similar procedure with *Aiptasia annulata* and Stoichactic. Specimens were alternately fed filter paper soaked in meat juice, and crab meat. The animals accepted four pieces of paper, whereupon they refused the fifth. But responses to meat likewise ceased at that point. Jennings' conclusion that loss of hunger was the explanation was apparently tenable, since, as he showed, nonstimulated tentacles were affected: he applied food alone to the tentacles on the left side, which refused it in seven trials. The tentacles on the right side were found to act vigorously. Shortly thereafter the tentacles of the *left* side accepted proffered food four times, though sluggishly; and when finally the tentacles on the *right* side were again stimulated with food, no reaction occurred, even though the tentacles of that side had reacted only once, and that fifteen minutes previously.

Allabach (**1**) was able to eliminate hunger as a variable by repeating the alternative feeding with Metridium, except that she did not allow either paper or meat to be swallowed. It turned out that whether ingestion actually occurred was immaterial to the phenomenon of response decrement. In addition, Allabach showed that loss of response occurred in about the same number of trials whether all pieces offered were meat or filter paper. In her opinion, local exhaustion of the normal supply of mucus to the tentacles of the animal is the explanation.

Gee, working with the California shore-anemone, *Cribrina xanthogrammica* Brandt, has amplified these data considerably (**38**). He precluded muscular fatigue by showing that touching tentacles with a glass rod 12 times produced 12 vigorous contractions, and that thereafter the tentacles accepted food the normal number of times. By injecting beef broth he produced a "satiated" animal exhibiting little or no contact receptivity. His conclusion that a loss in sensitivity was due to secretion of mucus does not concern us here, but his demonstration that scraping

mucus from "satiated" tentacles does *not* make the latter more sensitive is of interest. Evidently, loss of sensitivity is not due to a covering up of the sensory cells by the mucus but is due to a physiological change within the organism—Gee suggests that some substance may act directly on the nerve net in the tentacle much in the same way as an anesthetic.

More recently Parker (**83**) has considered this phenomenon and has concluded that a transfer of decrement does take place between tentacles. He believes that an almost immediate transfer of substances from cavities of the tentacles to the sensory mechanism adequately explains the transfer of decrement with food as the stimulus. With filter paper as the stimulus, on the other hand, he conceded an habituation factor of some sort, intimating that confusion has arisen from the fact that there are patently other kinds of fatigue than muscular and sensory.

The evidence of long-continued effects of feeding filter paper to sea-anemones as provided by Fleure and Walton (**33**) should convince one that the results of Nagel, Parker, Jennings, Allabach, and Gee are not altogether understandable in terms of lowered receptivity. Fleure and Walton placed filter paper on the same tentacles of Actinia once a day. Within the next few days the tentacles would no longer accept the paper unless a week or more had elapsed. Apparently there was evidence of transfer to other tentacles. It was alleged that even more striking results were obtained with Tealia. Such behavior would represent a *tour de force* of the first water for many higher species.

Summary of Coelenterata. The range of habituatory behavior is quite wide for coelenterates. In the Hydra, behavior hardly as variable as in the fixed infusoria is found. If expansion be allowed between contractions, no variability in the direction of habituation seems present. If the tapping continue during contraction, however, expansion nonetheless occurs in about a minute.

On the other hand, a much more efficient modifiability is possible to the sea-anemone, response decrement occurring sometimes after only one or two stimuli. In addition, habituation of contraction appears even though several minutes elapse between the moment of complete expansion and of a subsequent stimulation. Also, the duration of contraction becomes shorter and shorter—a factor definitely not present in lower forms.

Although the factor of loss of receptivity is by no means clear in the sea-anemone's rejection of food, there is evidence that habituation does occur in the similar rejection of a neutral substance. Indeed it is even alleged that such habituatory effects persist and are cumulative for a matter of days.

Phylum: Echinodermata

Class: *Echinoidea.* Von Uexküll early reported (**111**) that, when exposed to repeated shadows, *Centrostephanus longispinus* did not exhibit the typical spine-raising reaction to a fourth stimulus. We may infer,

since this response is lost after section of the radial ring, that no simply local loss of reactivity occurs in the decrement of which we speak, but that quite a complicated response, involving specialized receptors, conductors, and effectors is prevented from functioning.

Holmes (**56**) has confirmed von Uexküll's results in all details. In addition he claims that after habituation to shadows in the normal animal, a few minutes' rest may reinstate the response. Another response, that of moving away from a partially directive light, was observed to drop out as well. Specimens of the sea-urchin, *Arbacia punctulata*, were placed in a dish near a window after having been partially dark-adapted. The animals slowly moved away from the window to the farther end of the dish. If the dish were rotated 180° the animals moved again to the opposite end; but this did not go on indefinitely—a few such reversals sufficed to make even strong sunlight ineffective. Here the factor of light-adaptation is obviously not controlled.

Evidence that something more is involved, however, was provided by Holmes when he discovered that either mechanical or chemical stimuli would restore the original "phototaxis." The author suggests that the activity level of the organism was raised by these other stimuli, such activity then being directed and controlled by the light. If this is true, the original dropping off of the response was probably not due wholly to changes in light sensitivity.

Class: *Holothurioidea*. Crozier (**14**) reports that upon repeated shading, the reaction-times of *Holothuria surinamensis* Ludwig sensibly lengthen. However, the shading was carried out every half-minute, and it is known that in this species light- and dark-adaptation occur in a matter of a few minutes.

In response to repeated tactual stimuli, holothuria will quickly habituate. Grave (**42**) first observed this for the sea-cucumber, *Cucumaria pulcherrima*. He studied the contraction of the tentacles of this species to mechanical stimulation. That this response is very readily elicited was demonstrated by Pearse (**85**). When Pearse first brought specimens of another sea-cucumber, *Thyone briareus* Lesueur, into the laboratory, he remarked that any slight shock delivered to the container would elicit a complete tentacular contraction. If left in the laboratory and manipulated occasionally, it was noted that these animals underwent a deep habituation to mechanical stimuli, so profound indeed that the tentacles themselves might finally be touched with some force and still make no response. From the time relations involved, it is not possible to ascribe this decrement to receptor dulling or to effector fatigue.

Summary of Echinodermata. The rapidity with which echinoderms adapt to light and to dark render data from shadow-reflex studies equivocal on the subject in hand. There is only slight evidence for nonsensory habituation to repeated photic stimuli.

Rapid and long-lasting habituatory effects occur in holothurians in response to mechanical stimuli. In this respect they are considerably more efficient than coelenterates.

Phylum: Platyhelminthes

Class: Turbellaria. Pearl (**84**) stimulated mechanically the anterior parts of *Planaria dorotocephala* Dugès and *P. maculata* Leidy, finding that the originally convulsive movement could be observed to decline in magnitude. Although conditions of stimulation are not thoroughly reported, it seems fair to regard this as evidence of habituation.

One of the typical behavior patterns in planaria is the coming to rest shortly after stimulation with continuous light. A suggested explanation is that light adaptation has occurred. Walter (**114**) doubts that this fully explains the phenomenon, since the time it takes for a species to come to rest seems to correlate highly with measures of fatigue. This inference is not too far-fetched for us temporarily to accept, and has especial point here when we see that Walter's measures of "fatigue" are in all probability instances of habituation rather than of primarily muscular failure. As an index of fatigue he combined two measures of decline in rate of locomotion. The correspondence for four species, between so-called fatigue and time of coming to rest in strong light, is quite high.

An interesting case of habituation to rotation was also reported by Walter in this experiment. Upon slow rotation in the horizontal plane the fore part of a planarian's body raises up without disturbing the rear motion. If this rotation is repeated at half-second intervals, the worm halts with more and more uncertainty, and in a dozen trials it responds no more. After a 30-second interval the effect is altogether gone.

An instance of habituation to photic stimuli which is clearly not sensory adaptation is provided lastly by the same author. Walter set up a field divided into two sharply-defined areas of different light intensity, and induced planaria to cross repeatedly. Number of wig-wag responses of the head at the demarcation line declined in successive 25-trial averages thus: 84–76–48–32.

Class: Trematoda. In the holostome larva *Cercaria Hamata*, Miller and Mahaffy (**73**) showed that only one or two shadows, if repeated at one- to two-second intervals, were followed by the spurt of swimming characteristic of the species. However, this habituation was extremely short-lived—a few minutes at best. In a six-minute period with no shadows, five *C. Hamata* indulged in 100 brief bouts of swimming, while in a similar period with shadows once a second, only 40 such swims occurred. These time intervals were composed of eight alternate banks of stimulation and nonstimulation, each bank of 90 seconds duration. From the first to the fourth trial no evidence of habituation was apparent; obviously a minute and a half is sufficient completely to rehabilitate the response.

The same authors investigated mechanical stimulation for the same response. When 20 specimens were touched immediately following a swim 25 times each, all but 17 of the 500 stimuli were effective. Of some individuals stimulated until "fatigued," one swam 120 times, another 79. It is true that successive reactions became weaker and weaker; nevertheless the difference in number of stimuli necessary to habituate the swimming response of this animal with shadows and with touch is obvious. The argument of the authors for a dual mechanism is not justified, however, when the difference in rate of stimulation is considered.

Summary of Platyhelminthes. The structural possibilities for habituatory phenomena in Planaria have not been systematically exploited. Habituation is present in Turbellaria to mechanical stimuli and probably to continuous light. In Trematoda it seems that whatever habituation exists is transient at best.

Phylum: Annelida

Class: Chaetopoda

Subclass: Polychaeta. Hesse (**53**) early observed that repeated shadows cast on *Bispara voluticornis* quickly lost their stimulative effect, and this was confirmed by Bohn (**6**) for the same species.

In the tube-dwelling worm, *Hydroides dianthus* V, Yerkes (**123**) found that to repeated shadows the animals retracted themselves into their tubes less and less often. When stimulated at intervals of from one to twelve seconds in banks of 10 stimuli, all specimens habituated. At longer intervals this was not found to be true.

Hargitt (**46**) agrees with Yerkes that if a sufficiently long time interval be allowed to elapse between adjacent stimuli, habituation will not occur even to the weak intensities. He differs, however, in the duration of this interval: with shadows cast by a second-pendulum on *H. dianthus*, little or no variation in response occurred. At half-second intervals a few strokes of the pendulum were sufficient to produce habituation in many worms, while at quarter-second intervals this was practically universal. He further noted that other specics, *Potamilla oculifera* and *Sabella microphthalmia*, did not give clear-cut responses, and that occasionally more than one shadow was necessary to cause a contraction. A later experiment yielded similar results (**48**).

The difference between the maximum interstimulus-interval as reported by Hargitt and by Mrs. Yerkes for the same species can perhaps be referred to the past background of the individual specimens used. This is made possible by a further experiment of Hargitt (**47**) on the same species, in which he showed that specimens from shallow water made 79 responses to light increase out of a possible 100, whereas specimens from deeper water (8–20 fathoms) made only 19. That this was due to previous environmental conditions was indicated by the demonstration that keeping specimens in dim light for many weeks reversed the behavior characteristics of shallow-water individuals.

In the same experiment Hargitt showed the influence of tactual stimulation on the withdrawal response. With comparable stimulation intervals, results similar to photic stimulation were obtained.

Subclass: Oligochaeta. A brief paper by Gee (**39**) claims that the leech, *Dina microstoma* Moore, habituated rapidly both to mechanical and to photic stimulation. The author believes that loss of receptivity together with "slight changes in the nerve centers involved" probably explain the decrement.

Summary of Annelida. In spite of quite advanced morphology as compared with lower forms, no new and more efficient types of

habituatory phenomena have been uncovered in the annelids. On the other hand, the features of quick and long-lasting habituation have been met with in all of the few responses studied. The exact effect of standard, long-continued environmental conditions has been delineated for the first time.

Phylum: Mollusca

Class: Amphineura. In two experiments on *Chiton tuberculatus*, Crozier and Arey (**15**) and Arey and Crozier (**2**) studied the habituatory effects of repetitive photic and tactual stimulation. The retraction of the tentacles to shadows quickly habituated at interstimulus-intervals of less than ten seconds—with longer intervals, habituation was not exhibited till after fifty or more trials. It was noteworthy that a nearly-habituated response was reinstated if two or more shadows "in quick succession" occurred.

Class: Pelecypoda. Even in these eyeless molluscs habituation to a very few stimuli may persist for quite a while. Nagel (**77**) found this period to be a matter of hours in the case of sudden light decrease even though only one or two reactions may have occurred. Again, the same experimenter showed (**78**) that, after a number of shadows had been presented on one day, the next day's results were definitely affected.

Parker (**95**) has confirmed Nagel's statements in the former's experiments on the clam, *Mya arenaria*. The withdrawal of *Mya's* syphon to light is an exceptionally good and clear-cut response, which decrements in extent from trial to trial on any one day; moreover, the average of a series of trials on successive days will decrement likewise.

An almost identical phenomenon is observed in the scallop, *Pecten*. Hargitt (**46**) quotes Patten to the effect that in this species habituation to shadows may proceed to zero so that even the deepest of shadows produces no effect.

Class: Gastropoda. In the lower gastropods, the nudibranchiates, the interval between shadows must be very short (three to seven seconds) for habituation to occur (Piéron, **89**). Again, Piéron showed (**92**) that *Doris pilosa* profits least of the gastropods by stimulation. Crozier and Arey (**16**) tested response decrement of the nudibranch, *Chromodoris zebra*, to shadows and to mechanical stimuli. When the tentacles were touched at 10-second intervals only slight habituation was evident in 50 trials. This effect was independent of intensity of stimuli. With shadows, even 30 seconds could be used and still quick habituation occurred (three to four trials). Another nudibranch, *Facelina goslingi*, showed much greater resistance to habituation: 12–15 shadows produced no habituatory effect; it is possible that the relatively long refractory period (thirty seconds to one minute) accounts for this resistance.

In the marine snail, *Littorina obtusata*, Piéron (**92**) has performed a careful and extensive investigation into the effects of repeated shading. Individuals were placed in strong light and subjected to 15 shadows, each of one second duration, at each of seven different interstimulus-intervals. After a rest period of 30 seconds, this series was repeated as before.

When the number of shadows necessary for the response to disappear is plotted against the interstimulus-interval (the latter ranging from three to 120 seconds) a sharply decelerated curve results. Under these conditions the most efficient spacing of shadows for habituation to occur in the littorine is about one per minute. This spacing contrasts sharply with the more efficient intervals in any of the lower forms. Another highly significant improvement in the gastropod is its ability to profit over a considerable period of time. When Piéron administered the usual 15-shadow series with one-second interstimulus-intervals, allowed a variable interval to elapse, and then repeated the series, a measure of "savings" for each interseries-interval was computed by dividing the number of reactions of the *first* series into the *difference* between the number of the first and of the second series. With a two-minute interseries-interval, the savings was 77.7 per cent. However, with a full hour between series the savings was still 70.8 per cent. Another species, *L. littorea*, was somewhat less efficient.

A very important observation of Piéron's on the similarity between savings for shadows and for mechanical stimuli needs confirmation. He found that in one *L. littorea*, even though more shocks were necessary to produce habituation, the savings for shadows and for mechanical shock were indistinguishable at the five-minute interseries-interval (75.9 and 74.3 per cent respectively). Such an observation, if confirmed, would argue strongly for a single central mechanism of habituation in the marine snail.

Contraction of the antennae to mechanical stimulation in the fresh-water snail was studied by Dawson (**20**) as a function of conditions of habitat. The widest variations in reactivity were observed, one specimen "so sensitive that it reacts to a breath upon the film," another of the same species responding only to actual tapping of the antennae. That this difference was due to factors such as amount of handling and general disturbance, was proved by keeping a "tamed" snail undisturbed for weeks, while subjecting a sensitive snail to maximum handling for that period. In this case a complete reversal of physiological condition was exhibited, the "tamed" snail now being as reactive to stimuli as the sensitive one formerly was. Dawson's observations were made on a large number of individuals of eight species of Physa.

Several responses of *Physa gyrina* Say have been shown by Thompson (**110**) to decrement upon repeated stimulation. When first handled, for example, these animals expel air from the lung and drop to the bottom of the water; but upon repeated handling this ceases almost completely. Again, upon manipulation the normal mouth movements of the snail will start up after a preliminary period of decrement. Mouth movements to food were found to be decreased if the food was quickly and repeatedly withdrawn.

In the land pulmonata, Humphrey (**57**) investigated the withdrawal of antennae in *Helix albolabris* to a jerking of the substratum. Stimulation at two-second intervals was followed by loss of this response in from a few trials to sixty-three. That this response may vary in "depth" he showed by allowing a 30-second rest period to elapse after decrement

was complete. The response was thereby reinstated; but subsequent 30-second rest periods were of less and less effect.

In another land snail, *Limnaeus*, withdrawal of the whole exposed part into its shell was found by Buytendijk (**10**) to occur whenever the animal was removed manually from the substrate. After a time it would again extend its anterior portions. It was observed by this worker that, provided the snail was not roughly manipulated, the extension took place in less and less time.

Piéron has provided us with quite an impressive variety of data on habituation in *Limnea stagnalis*. A series of papers (**88–92**) deals with this subject as a function of habitat, interstimulus-interval, and interseries-interval. As to habitat, Piéron noted that individuals from small streams overshaded by many trees habituated to shadows with greater celerity than specimens from the open sea. In the latter, habituation occurred in 7 to 11 trials, but all effects were lost in twenty-four hours. One series of 22 consecutive days showed no day-by-day habituation. Such data emphasize the care which must be taken to specify previous conditions of the subjects, and serve to warn us against accepting quantitative data from this situation as more than tentative on certain points.

In one experiment Piéron (**89**) compared the number of shadows necessary to habituate *L. stagnalis* while varying the interstimulus-interval: only one tap was necessary at 5- to 8-second intervals; seven or eight were necessary at 10-second intervals; eleven to twelve taps at 20-second; and sixteen to seventeen at 40-second intervals.

Piéron in this study used habituation as a tool with which to study the "law of forgetting." He presented 15 shadows at 10-second intervals, each shadow of quarter-second duration. He allowed variable periods of time to elapse (20 seconds to 20 hours), whereupon the series was repeated. The measure of savings was then computed as outlined above. The author was struck by the resemblance of the resulting curve to that of Ebbinghaus for forgetting, especially when the time of the snail data is read as if it were minutes instead of seconds. Piéron calculated the equation of the curve to be: $m = (K (\log t)a/t)$, where m = savings, t = interposed time interval, and K, a, and b are constants of the order of 230, .5, and .36 respectively. It was claimed that the value of these constants was very similar for "individuals of the same habitat." Plots of the obtained and of the calculated values of m show a remarkably close correspondence.

In another study Piéron (**92**) attempted to find the smallest number of shadows at one-second intervals which would, after variable periods of time, have no effect on later reactions. He reasoned that this would be a measure of "mnemonic effect." Using too few individuals for any great reliability, Piéron nevertheless succeeded in describing several curves for different periods of rest. His figures can be interpreted to mean, (1) that the more repetitions of the stimuli given, the longer an appreciable effect will last, (2) that the shorter the interstimulus-interval, the more repetitions will be necessary to produce the same effect, except (3) that increasing this interval longer than about five seconds will of itself have little effect.

From his extensive studies on habituation Piéron speaks with some weight. To explain the phenomenon in its many manifestations he rejects motor fatigue on the grounds that after habituation a variety of other movements involving the same musculature may be indulged in; he rejects sensory fatigue likewise, since, as he trenchantly puts it, "Can one truly speak of a fatigue of this order for shadows which . . . constitute rather a brief sensory respite?" He refers the decrement to "associative fatigue," allying it to the decrement in those vertebrate reflexes containing an intermediary neuron.

Class: Cephalopoda. Often rated as superior to the Arthropoda on account of its advanced sensory equipment, there is yet little evidence that the cephalopod, *Octopus vulgaris*, exhibits any more complicated behavior than other mollusks. Goldsmith (**40**) was able after a dozen repetitions to cause this species to refrain from approaching a disc of metal thrown into the water. The disappearance of this response closely paralleled that of a conditioned response, an example of which it may be.

Summary of Mollusca. The elaboration of coordinating ganglia and the advance in neural control of behavior found in all mollusks have apparently paid big dividends. Even the nudibranchs are capable of retaining the effects of habituation for hours and in some cases for days. There is considerable difference in the maximum duration of the interstimulus-interval possible. *Doris* shows little habituation with intervals over seven seconds, while the snail will habituate with much longer intervals—well over two hours. In this phylum, too, habituation is more independent of stimulus intensity. There is some evidence that habituation to photic and to mechanical stimuli follows the same course. On the basis of this and other facts, Piéron, the most extensive investigator of habituation in this phylum, believes habituatory effects to be expressions of a central change in the organism, probably in the nervous system.

Phylum: Arthropoda

Subphylum: Crustacea

Class: Cirripedia. The shadow-reflex in *Balanus*, the common barnacle, consists in general contraction and in momentary cessation of respiration. Pouchet and Jobert (**97**) discovered that barnacles attached to keels of boats, which are usually shaded, do not react to shadows as readily as those fixed on open rocks. This observation is counter to the usual one, and indeed has not been confirmed. The statement that those specimens below the surface react to shadows but not those specimens on the surface (because for an animal below the surface a shadow has especial significance), is not supported by evidence that one and the same specimen will exhibit these differential reactions in reasonably close temporal proximity.

Piéron calculated the "savings" of *Balanus balanoides* when exposed to two series of 15 shadows in 15 seconds (**92**). The savings for a two-minute interseries-interval was 73.3 per cent that for a five-minute interval, 48.5 per cent. This is seen to be much less than in the gastropod under similar stimulus-conditions.

Temperature changes will affect the length of time *Balanus improvisus* stays contracted to shadows, according to von Buddenbrock (**9**). At 5° C. this time is over two minutes long. This observation, together with the statements that the time varies with shadow intensity and with shadow duration, is impossible to evaluate correctly since purely sensory factors cannot well be distinguished.

Subphylum: Insecta

Class: Coleoptera. It is equally difficult to evaluate the decrement in duration of the death-feigning in the beetle, *Tychius picirostris* (Du Porte, **29**). It was demonstrated that both temperature and duration of stimulation affect this response. Although no refractory period exists for this response longer than a few seconds, according to Du Porte, and again Bleich (**5**), still the latter has demonstrated that day-by-day habituation does occur. If the beetle, *Silpha obscura* Linn., is stuck with a pin between the meso- and metathorax dorsally, an immobility will set in which will last from a few seconds to three minutes. The day-by-day habituation of this response bears a general resemblance to that of Limnea.

Class: Lepidoptera. The rather violent reactions to continuous sound in the larvae of *Vanessa antiopa* Linn., the mourning-cloak butterfly, were observed by Minnich (**74**) to become weaker and weaker and finally to drop out altogether. When this was repeated at five-minute intervals, only a small degree of habituation was obtained. In a few specimens stimulated to zero response with a 256 d.v. tuning fork, no response was observed immediately afterward to forks of 384 or 512 d.v.; if "fatigue" was complete to the 384 d.v. tone, no response was observed immediately afterward to forks of 384 or 512 d.v.; if "fatigue" was complete to the 384 d.v. tone, no response would be given to either the higher or the lower tone (with one exception); but if an animal was "fatigued" to the 512 d.v. fork, reactions could always be elicited with the 256 d.v. and in fifty per cent of the cases with the 384 d.v. tone. This interesting result may be allied with the phenomenon of generalization as it appears in the vertebrates, or it may simply indicate that the original stimulating power of the lower tones is greater in this species. The latter seems more probable.

Class: Diptera. Holmes remarked (**55**) that with repeated light stimulation the response of mosquita larvae decrements rapidly and decidedly. These animals come to the surface of the water in sunlight, but if a shadow passes over they swim rapidly towards the bottom. After a number of shadows few larvae are seen to dive. This is confirmed by Goldsmith (**41**).

Class: Hymenoptera. Habituation in this important class is as yet not systematically studied. In the many books by the great naturalists on ants and bees, references are found only to isolated cases where individual animals have given over attempts to perform some act or have ceased some activity for unknown reasons. Thus, Wasmann reports (**116**)

that ants will shortly forego the fighting attitude if a finger continues to move outside the nest. Again, Fielde (**31**) states that ants, which ordinarily avoid ultraviolet light, "become used" to it in a short time. In these and a hundred other cases from the field, the stimulus conditions and the background of the individuals are so imperfectly known that no advantage is to be gained from listing them.

Subphylum: Arachnida

Class: Araneida. One of the earliest extensive accounts of habituation is the classic experiment of the Peckhams (**86**) on the spider. They observed that if a tuning fork was held near the animal it would drop off its web, wait a period, and then clamber back up its line. The full account of one specimen of *Epeira labyrinthea*, the most excitable species, is enlightening:

> Not until she had fallen out of the web 22 times, at the approach of the fork, could she restrain the impulse to drop. It was apparent, however, after the seventh or eighth time, that she was less startled by the sound than at first, since the distance that she fell and the period of time that elapsed before she returned to the web grew shorter and shorter in the later experiment. At first she fell 15 or 18 inches, and remained at the end of her line for several minutes, while toward the last she fell only an inch or two, and immediately ran back to her web. After the twenty-second trial she only held up her legs as the fork approached. Finally, completely worn out and disgusted, she retreated to a neighboring branch, drew in her legs, and remained sullenly unresponsive to all further attempts (p. 392).

Summary of Arthropoda. The lack of careful studies of habituation in this phylum is much to be regretted, especially in the interesting and morphologically advanced Insecta. Few generalizations can be made. What data there are show no more efficient habituatory phenomena than in Mollusca. There is the slightest bit of evidence that habituation to stimuli qualitatively close to the original habituatory stimulus may occur.

Phylum: Chordata

Subphylum: Vertebrata. Phylogenetic advances of this highest subphylum, especially the development of a dorsally-placed spinal cord and of a proportionately huge anterior brain, lead one to expect great increases in behavior modifiability in the habituatory direction. This indeed turns out to be the case. In addition, there is enough similarity in this type of modifiability among vertebrates so that responses to types of stimuli may readily be compared without considering classes separately.

Mechanical stimulation. Humphrey (**59**) has made some very important observations on the musk-turtle. He clamped the animal down and led a fine thread from the right hind leg to a kymograph. When the shell was tapped with an electric hammer

at two-second intervals, habituation set in by the seventh trial. In this respect the turtle is in no better case than any invertebrate; but Humphrey showed that the turtle is capable of "dehabituation": If the shell was smartly struck with a mallet near the locus of the original tapping, a response occurred, and moreover, taps *of the electric hammer* were now effective. Upon continuing the taps the response again died out. But it was significant that further mallet strokes did not suffice to reinstate the response to the taps. The author suggests that possibly two processes are involved, namely, habituation to the mallet strokes, and a deepening *below zero* of habituation to the hammer taps. In view of the fact that even the second mallet tap was almost completely without effect, it seems probable that the second of these processes is much the more likely in this case.

A related topic is the fact discovered by Dennis and Sollenberger (**21**) that rats will tend to choose maze alleys into which they have not recently gone, and especially the demonstration that the rat in a nonreward maze situation makes fewer and fewer entrances into alleys in successive minutes. The authors state their opinion that habituation is important as a mechanism in maze learning. Plots of the successive decrements per minute reported for three mazes do not always show the negative acceleration of more typical habituation curves—in one case indeed an initial increase is the case—but it is certain that several factors were operating in the situation which tended to obscure pertinent data. Also, it is probable that the shape of the curves might be somewhat more typical of habituation had results in successive half-minute steps been taken.

Habituation of a response under control of mechanical stimulation in man may be extremely resistant to habituation. Lombard (67) early showed that, although the human knee-jerk was susceptible to many variations, no truly habituatory effect appears. He administered up to 29 strokes at 15-second intervals several times a day over a period of six weeks.

Two modifications of Lombard's general conclusion are necessary in the light of more recent work: Wendt (**117**) intimated that habituation might have been operating to reduce the facilitative effect of the elicitation of one knee-jerk upon that of the opposite side. Dodge (**25**) administered stimuli consisting of pairs of taps on the patella, a half-second interval between taps of any pair. Over a period of 21 months, 1032 knee-jerks were recorded. From month to month only a slight increase in latency of the second tap was indicative of a decrement—on the average, however, the amplitude of the second response was about one-third less than

that of the first. There is, then, some slight indication of habituation over extended periods in the knee-jerk.

An experiment of Bass (3) shows, moreover, that the failure of Lombard and of Dodge to secure habituation within a single day is not universally true. He gave 100 stimuli at about ten-second intervals to young men and found a gradual reduction in amplitude of response throughout the period. This decline at first glance seemed more apparent under sleep, but it was noticed that objective measures of sleep showed a decline almost identical with that of the amplitude of knee-jerks under sleep. The superficial similarity of this latter curve to typical habituation curves is thus seen to be deceptive. Taking this into consideration, the curves of habituation in the waking state and under sleep decline at comparable rates. What this may indicate is at present undisclosed.

Habituation of the abdominal reflex of young men to a brief tactual stimulus is reported by Lehner (66). The number of stimuli needed to produce a zero response after successive dehabituations followed a negatively accelerated course.

Labyrinthine stimulation. Prince (98), interested in validating nystagmus as a reliable clinical sign, rotated normal cats 20 turns in 20 seconds, every two minutes for 20 consecutive days, fifty to sixty times a day. He noticed that the duration of post-rotation nystagmus varied slightly in different animals, but that a high degree of stability was retained. This result is inexplicable in view of all later work. Griffith (43), for instance, rotated white rats at a speed only three-fourths as fast as Prince. Ten banks of 10 rotations each were given two to three times a day. Under these conditions, noticeably less intense than Prince's, post-rotational nystagmus disappeared for 20 rats in 12 to 19 days. Ocular movements likewise were reduced from 18 to 25 on the first rotation to only one or none in ten banks or thereabouts. It was characteristic that the responses each day began a little lower than on the preceding day, and that the average for the first two banks on any day was always higher than for the last two banks of that day. Also, two rats rotated in the morning and again in the evening showed consistent decrease on the latter occasion each day, but group-to-group comparisons were not run to discover whether this was due to habituation or was a function of the time of day.

Fisher and Babcock (32) demonstrated habituation of after-nystagmus in man. With subjects given only one turn to the right and one to the left every day, an analysis of their data shows that

the mean of the last half of a one-day's series is less than that of the first half.

Maxwell, Burke, and Reston (**72**) considered in the rabbit both duration of nystagmus and number of eye movements after rotation. Five animals with head fixed and five with head free were rotated 180° per second 200 times a day. The curves of decrement for the two functions are strikingly similar in all details, indicating in all probability a common mechanism. It may be that the form of these curves is the typical one for a response somewhat resistant to habituation. The authors obviate muscular fatigue and sensory adaptation by producing nystagmus with aural irrigation immediately after the response disappears to rotation. The senior author later showed that the response habituated with far fewer trials than did nystagmus *during rotation* (**71**). At a time when post-rotation nystagmus had practically disappeared, rotation nystagmus had not usually been reduced as much as 50 per cent. The author indeed doubts whether the latter would ever completely disappear under these conditions.

Griffith (**44**), studying rotation in man, stated that a day-to-day decrease as well as that within a single diurnal series was found for duration of post-rotation nystagmus, number and amplitude of nystagmic eye movements, time of apparent movement of the visual field, and post-pointing.

Dodge (**24**) corroborated Griffith as to the decrease of post-rotation nystagmus from day to day and during any day's series. He specified the form of the decrement to be negatively accelerated, at least in the latter case, and speaks of a "contral compensating factor" operating in the situation, recognizing a differential effect of repetitive stimulation on the mechanisms of pursuit and of quick recovery.

Dunlap (**27**), furthermore, established that habituation of nystagmus in the rabbit is a central phenomenon by showing that irrigation of the left ear produced habituation not only in that ear, but affected subsequent behavior to irrigation of the right ear as well. Another bit of evidence that a central process is involved comes from Fearing and Mowrer (**30**), who anesthetized pigeons, then subjected them to rotation. They regard their failure to secure habituation in this case as proof of some central nervous change of a "purely functional" sort.

Mowrer (**75**) established the principle that habituation to rotation of pigeons in *both* directions, as a result of rotation in *either*

direction alone, depends in part on the relative length of the rest periods interpolated in the original habituation series, thus: the shorter the rest periods allowed, the more effective would rotation to the *right* be on nystagmus to subsequent rotation to the *left;* and vice versa.

Somewhat different results were obtained by Mowrer when the environment (a cylinder of black-and-grey stripes) was rotated instead of the bird. After-nystagmus to this type of stimulus does occur, but tends also to habituate. When the environment was rotated in the counter-clock wise direction, no habituation was apparent in subsequent tests of *clock-wise* direction.

The partial dependence on the cerebellum of the habituation of this response in the pigeon was demonstrated by Halstead (**45**). Four months to a year after twenty to eighty per cent of the cerebellum had been removed, no difference between normals and operates was apparent with regard to the onset of habituation; but on testing at two or four weeks for retention, the operates had lost approximately half of the effect; normals, none.

The habituation of nystagmic head movements in the guinea pig has been studied by Smith (**108**) as a function of neural integration. An environment of black-and-white stripes was rotated slowly until nystagmus disappeared. A normal animal would habituate to such rotation in 2.6 minutes. With operated animals, however, the picture is much different. Under *right* lateral hemidecortication, habituation to clockwise (CW) rotation occurred in four minutes; but to CCW, not in half an hour. The converse was equally true under *left* hemidecortication. Apparently the operated animals were incapable of habituating to an environment rotating from the operated to the normal side.

Auditory stimulation. The supposition that those responses with relatively long refractory periods are first to habituate was made by Dodge and Louttit (**26**), from data on the guinea pig. In this animal they studied the progressive decrement of response to the same repeated stimulus—a loud click. Unfortunately for the present paper, the data obtained in this exploratory study are far from completely reported. Cohen (**12**) has amplified the data somewhat. He showed that the body startle of the guinea pig will decrement from day to day, the extent of loss depending in a peculiar way on the conditions of stimulation. Animals were given ten pairs of clicks a day for twenty consecutive days, but in four groups the interval between members of a pair was 1, 2, 3, or 4 seconds. Thirty-second rest periods elapsed between all pairs.

The initial reactions to the *second* of the pairs never averaged over a quarter-millimeter in amplitude and may be disregarded. The results show, however, that although bunching the stimuli of a pair closer together does raise the level of the response to the *first* of that pair, yet the decrement rate of this first response is similar for all groups.

Clarification of habituation in the body startle of the rat has been afforded us by Prosser and Hunter (**99**) in their study of the relation between habituation and interstimulus-interval; and they have clarified the characteristics of habituation as delineated by spontaneous recovery and by dehabituation. These authors were able to record bursts of discharge of potential from the gastrocnemius muscle of the rat in response to a click. Clicks at intervals of two to five seconds caused much quicker habituation in terms of muscle units firing, than did clicks at ten- to fifteen-second intervals. Latencies and magnitudes of individual units were apparently unchanged. "The effect is as if the threshold for different units became higher, each dropping out at some level without undergoing any change in its time relations" (p. 610).

An attempt was made to study the degree or depth of this habituation by the techniques of spontaneous recovery and dehabituation. Thus, if a response were habituated, a brief rest (15 to 20 minutes) would reinstate it. If, however, habituation were induced again, a longer time had to transpire before the response would become normal; and furthermore, the more stimuli, the longer the habituation lasted. Similar inferences on depth of habituation may be made from dehabituation data. The authors habituated the response of a reactor, and then introduced dehabituatory stimuli in the form of opening the box containing the animal, or of flashing a light. Response to the click was thereby re-established; and again paralleling the previous results, the deeper the habituation, the stronger the dehabituatory stimuli had to be to reinstate the original response.

Lehner (**66**) has found that the number of stimuli necessary to habituate the respiratory startle of the normal rat decreases with succeeding habituations in a day's trials. The curve of this decrement takes the form $N = C(E - E_0)^{-n}$, where N = number of stimulations, E = the ordinal number of the habituation in the series of habituations, E_0 places the curve on the abscissa, and C and n are constants of the order of 30 and 1.1 respectively.

Landis and Hunt (**65**) have found this picture of habituation to be essentially true for the startle reflex in man. All components of the startle except the lid reflex and slight head movements drop out, though with great variability among individuals. Apparently, however, habituation of the eyelid reflex never completely

occurs to a service-calibre revolver fired over a period of years.

Habituation in the rat of long-latency bodily activity in response to two seconds of a complex auditory stimulus was studied by Harris (**50**). A series of ten stimulations was scattered over a daily three-minute period for ten days. Both serial and diurnal results show the pronounced negative acceleration similar to that commonly reported.

Oldfield showed (**81**) that in the normal human, rapidity of habituation of the eyelid reflex to sound depended upon the intensity of the stimulus, the rapidity varying from an irregular oscillation with a painfully loud click to complete habituation in one or two trials with a click just above threshold. Oldfield remarks that dehabituation was accomplished most readily in a response habituated by the more intense stimuli.

Data on habituation of the GSR in 187 adults, as a function of interstimulus-interval and as a function of generalization, has been provided by Coombs (**13**). A variety of loud sounds and a "pure" tone were used. For all stimuli initial habituation was rapid, then slowed to a low level. As to generalization, the author concludes that habituation is in part general and in part specific. It is to be noted that this conclusion can apply only to the modality studied.

Davis (**19**) has similarly investigated this phenomenon, using a 1000 d.v. tone. Usual decrements from trial to trial and from day to day were found. It was emphasized that habituation did not proceed on control experiments with *no* sound.

Some slight indication that habituation transfer is possible from one modality to another is given by Porter (**96**). Light or bell was given first in random order for six to seven days. A tendency, not statistically reliable, existed for the second of the pair to take fewer trials to habituate completely.

Electric shock. Harris reports (**51**) that habituation in the black rat appears when amplitude of response to 1 ma. of shock is plotted against successive days' trials. Ten trials were given per day; but although a typically negatively accelerated curve appeared, response to shock was still marked by the end of the tenth day.

The Sewards have studied in the adult human female the effect of repetition on reactions to electric shock (**106**): records were secured of GSR, respiration, thickening of the thigh muscles, and of general bodily movement. Relatively weak momentary shock was applied to the foot five times a day at one-minute intervals.

All responses decremented fifty to sixty-nine per cent of the original magnitude.

Miscellaneous stimulation. The habituation of responses to fear-producing stimuli—sudden dropping back of the subject's chair—was studied by Blatz (4) for cardiac acceleration, respiration, and GSR. Subjects were strapped into a chair for 15 minutes a day. On the fourth day, the chair was quite unexpectedly tilted back 60°; this was repeated on the fifth day. Some differences appeared in rate of habituation among the responses, but in some subjects, to three or more falls habituation of all responses was pronounced or complete.

Habituation of the GSR in medical students to words alone was shown by Syz (109) to proceed with many of the characteristics of less complicated situations. The percentages of students reacting to single words of high emotional content ranged from 16 to 84%; during a second repetition of the word list, this range dropped from the original to from 4 to 68%, the average percentage loss for all words being 16.3. One should note that those words to which most students responded in the first presentation sustained in general the greatest decrement.

Allied Phenomena. Brief mention must be made of several phenomena closely related to habituation.

In the human, for example, studies on affectivity and all the studies of "mental fatigue" since Mosso have regularly shown central decrement. In these cases, however, it is clear that the stimulating conditions are far too complex to be used as a reference point for characteristics of response. Again, the central locus of the effect which stimulation of one ear has on subsequent stimulation of the other ear—Rawdon-Smith's so-called "auditory fatigue" (100)—should be mentioned.

In the operated animal a number of ingenious experiments have been performed, experiments which undoubtedly have the utmost significance for the problem of habituation in intact animals. Vészi (112), for example, showed that in the frog "associative fatigue" demanded an internuncial neuron between receptor and effector. Sherrington (107) had, of course, met with a decrement in the reflexes of the spinal dog to which he applied the term "fatigue" only in the broadest sense. Prosser and Hunter (99) have argued the habituatory decrement in the reflexes of the spinal animal demands an internuncial synapse since a reflex provided with internuncial neurons in the spinal rat habituated, while in the cat a reflex *without* such neurons did not habituate after 800 elicitations. One of Hunter's students, however, has shown that the pupillary response arc, which contains several synapses, does not habituate (66).

A phenomenon analogous to habituation was disclosed by Dusser de Barenne and McCulloch (29). Stimulating with a unipolar electrode the exposed motor cortex of the anesthetized monkey, these authors found

that under certain conditions the second stimulus of a pair would elicit no motor response or at best a weak one. While every characteristic of *both* shocks influenced the response to the *second*, the most significant variable was depth of anesthesia. Under very deep Dial anesthesia, the interval between shocks which would be followed by lack of response to the second shock was one to three minutes. This interval in the non-narcotized monkey was only four seconds.

The experiment of Dusser de Barenne and McCulloch thus gives us what seems at first glance to be the cerebral factor for habituation. It would, however, be wise to exercise caution in the interpretation of results from intact animals in the light of this study. In the first place, the time relations producing decrement and increment are too sharply defined by these authors. Bunching the second stimulus of a pair closer than four seconds, for example, will produce "facilitation" in the monkey cortex, whereas on the contrary it is usually true that such bunching in the intact animal will tend to make habituation increasingly apparent. Since the absolute magnitude of the optimal interstimulus-interval may be expected to differ from preparation to preparation, however, this argument is not conclusive. Again, moreover, the authors' implicatin of the giant pyramidal cells of the cortex as the locus of the effect obviously cannot have bearing on habituatory results from non-cerebral species. Nevertheless, the discovery of these authors, that weak or even subliminal stimuli cause decrement, is in line with all expectations; and it is likely that the authors have put their fingers on at least one important component of habituation in higher animals.

If any were needed, the experiment of Smith (**108**) provides an illustration of the complicated nature of habituation. It will be recalled that nystagmus of guinea pigs with *left* lateral hemidecortication would habituate to CCW, but not to CW, rotation of the environment. But now when the remaining hemisphere was extirpated in a second operative stage, a complete reversal occurred such that habituation to CW stimulation shortly appeared, *but not to CCW*. It may be pertinent to remark here that when Dusser de Barenne and McCulloch extirpated all the cortical layers, a pair of stimuli which would produce decrement in the normal cortex now produced increment when applied to the white substance. In this connection will also be recalled Fearing and Mowrer's demonstration that anesthetizing the pigeon prevented the usual habituation of nystagmus.

While the temporal relations of stimuli are often quite different in typical habituation studies and in studies of the characteristics of synaptic discharge, the acknowledged importance of the latter in habituation makes necessary a statement on decrement at the synapse. Thus, in a recent study Bronk, Pumphrey, and Hervey (**8**) electrically stimulated fibres to the stellate ganglion of the cat, recording from postganglionic fibres. Certain frequencies of stimulation (above 80 per second) occasioned a "ganglionic block"; while frequencies over 200 per second produced an effect over a period of several minutes. These and many related results are highly interesting and probably important for the problem of habituation, but unhappily are not specifically informative.

In considering thus summarily such data it is possible to say only that several promising leads have been opened; an extension of any one of them would almost certainly add significantly to our understanding of the internal condition of habituation. For the present, however, it is impossible to attempt anything like a thorough-going interpretation of the internal factors of habituation in these terms.

IV. Discussion

In view of the writer's feeling that the general problem of habituation is best served at this stage by a preliminary statement of the precise conditions of its appearance and disappearance, discussion of the several questions usually put in this field will be reduced to a minimum.

The Significance of Non-reinforcement. There seems no doubt that a response which is reinforced in any of the common ways will not be markedly affected by habituation, although of course decrement may occur, as in satiation. It is also true that reinforcement of any habituated response will reinstate that response with all the characteristics of learned behavior. The significance of these statements for the furtherance of our understanding of the phenomenon of habituation is clear. The former makes it plain that habituatory phenomena may be overlaid with phenomena making for increment in response—the most complex conditions for the nonappearance of habituation are thus indicated. The exact nature of these conditions has not been elucidated, but attempts are being made in this direction (**52**).

Harmful and Harmless Stimuli. The question, argued at such length in the earlier literature, whether habituation will occur to "harmful" stimuli, rests, as has already been hinted, on a misstatement of the more important question of the range of intensity within which habituation will occur. There would be no occasion whatever to adopt the completely ambiguous older terminology even if it were true, which it is not, that all undeniably harmless stimuli may occasion habituation.

In this connection are germane the statements of Sherrington (107) as generalized by Humphrey (**59**), that habituation to stimuli of weak intensity occurs because the rising threshold produced by a weak stimulus rises faster than summation can overcome, whereas with the more intense stimuli the facilitating effect of summation increases more rapidly.

Habituation as an Active Process. This important question has seldom been asked directly of habituation as an independent phenomenon. The phraseology usually applied is, that habituation can proceed "below zero"; but it is fair to say that this implies something more than the disappearance of a certain process. A "below zero" level has been demonstrated for a wide variety of organisms and situations, and is very likely a fundamental characteristic of habituation.

But what is the nature of a process which can decrement below zero? Several highly suggestive conclusions have been drawn for the closely related field of conditioned extinction. Culler and his students (**7**) have shown that in the buzzer-shock situation, a dog will extinguish much sooner if shocked on the thorax for conditioned foot-withdrawal than when responses to buzzer are allowed to decrement in the normal fashion. Does habituation, then, partake of the nature of conditioning? Wendt (**121**) has demonstrated that in habituation of nystagmus not only does eye movement decrement, but the movement may actually be in the direction *opposite* from the original direction. Since the time when Dodge proposed (**24**) that habituation of vestibular nystagmus be interpreted as competition between nystagmic movements and a system of "still-fixation," Wendt has been the most plain-spoken in applying the principle of reciprocal inhibition specifically to habituation data, with his concept of competition between behavior systems for possession of the final common paths (**118, 119, 120, 121**). This concept seems to the reviewer to apply particularly well to very many different instances of habituation.

The Contribution to Habituation of the Effector Response. There exist no crucial data on this interesting question. Experiments on the relative effects of different energies expended in the habituation of a response would be welcomed.

The Role of Uniformity in the Sensory Field. Oldfield (**81**) gives us the most complete discussion on this topic, stating his opinion that the contribution of the sensory field to habituation is greatest when uniformity is greatest. He recognizes with Humphrey that modern space-time concepts permit the usage of the term unity in connection with a temporal series of stimuli as well as with simultaneous events. A certain plausibility attaches to this theory, and it is certainly more sophistocated than, for instance, Washburn's view (**115**) that habituation in the higher animals is occasioned by "lack of attention." Oldfield's "uniformity," however, like Humphrey's "re-establishment of equilibrium," is another

example of one of those partial truths which upon inspection are found to be analytically fruitless.

Habituation and Refractory Phase. The concept of refractory phase of response systems has been applied, largely on the weight of Dodge's authority, to habituatory decrement. Noting that a reaction system required a certain sensible time after its elicitation before a further stimulus would be effective, Dodge (**22, 23**) began the formulation of his laws of "relative fatigue," a series of general statements relating the disappearance of the reaction to stimulus conditions and to the state of other simultaneous reaction systems. These laws were later elaborated by Robinson (**103**) to fit conditions of work decrement. It is perhaps unfortunate that the term "refractory phase" should have been chosen for the phenonenon at the basis of these laws. As Hilgard has pointed out (**54**), the term has a much more specific meaning in nerve-muscle physiology; he proposes the term "phase of decrement" as being nomcommital. We may agree that a period of variable duration exists during which a reaction is (1) less easily elicited, or (2) more easily displaced by another reaction utilizing the same final common path; but the "laws" of relative fatigue can tell us little more than has already been said in other ways.

Is Habituation True Learning? So very large a proportion of the better workers in the field have either assumed or specifically stated the affirmative that a list would be superfluous. Instances of habituation, where behavior seems loosed from the close temporal ties of stimulation, have from the first been adduced to show a certain intelligence in animals. There seems no reason to question the similarity, at the very least, of mechanisms of conventional learning and of habituation. Hymphrey (**59**), in his admirable work, has been most articulate in systematizing the whole range of learned behavior, according to habituation the most uncomplicated level, indeed, but still regarding it as unquestionably a type of learning. The failure of some to recognize this characteristic of habituation is perhaps explained by the fact that learning in its more spectacular appearances takes the form of response increment—something new has been added. The statement of Wendt (**121**) that "positive and negative learning are not separable aspects of the problem of learning, but are always to be considered together," should emphasize the point sufficiently, while his demonstration (**118**) that habituation and true conditioning may take the identical form provides near-crucial experimental support.

V. Summary and Conclusions

Consideration has been given to some of the data from the field of habituation in the intact organism. The importance of this field has been conceded in its own right as a fundamental type of response decrement, probably not essentially different from so-called "true" learning. In addition, the point of view was advanced that in certain more complex learning situations habituatory decrement may be overlaid and obscured by other processes, and that for any accurate analysis of these complex situations a precise understanding of the nature of habituation is essential.

A review of typical habituation phenomena reveals a striking similarity throughout the phylogenetic range. Studies in the lower forms have been dwelt on to emphasize the phenomenon's independence of any particular structure. Even in the Protista are found the fundamental characteristics. With increase in morphological organization, changes in the possibilities for habituation occur in the direction of a lessened dependence upon stimulus intensity and upon number of stimuli, and a progressive freeing from a more or less restricted temporal pattern of stimulation. It is significant that in organisms so relatively simple as the Actinozoa, only a very few stimuli spaced several minutes apart may produce habituation—and that in the scarcely more complicated holothurians, habituatory effects may persist for a matter of hours. The elaboration of coordinating ganglia in the mollusks permits these animals to habituate with interstimulus-intervals well over two hours. In the Arthropoda, generalization of habituation may be present. In view of these and other developments, habituation in the vertebrate proves to be qualitatively no different from that in the lower forms.

Practically every index of habituation, when plotted as a function of time, is observed to follow a course rapid at first, then progressively slower. The universality of this observation marks it as a distinguishing characteristic of habituation.

Habituatory response decrement is envisaged as the resultant of external and internal conditions. The former have been reviewed for a variety of situations and organisms, certain similarities and generalizations having been noted. Several attempts to attack the latter were reviewed, and the conclusion forced that the whole question of the internal conditions of habituation must for the present remain open.

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THE PREPARATION OF BOOK REVIEWS

BY JOHN E. ANDERSON
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The *Psychological Bulletin* publishes many reviews of current books in psychology and related fields. By long established policy reviewers are given freedom to review books as they wish. This freedom implies an obligation to write in good taste and the realization that a good review is more than an expression of feeling. The editorial function is limited to indicating the approximate space available and to making such minor corrections as are necessary to meet style requirements. The reviewer, therefore, takes complete responsibility for the opinions he expresses.

A review differs from an abstract in that, in addition to some survey of the book's contents, it contains an evaluation. Since the *Bulletin*, with its wide circulation, goes to every Member and Associate of the Association, the reviewer owes his colleagues an accurate and fair evaluation in a vigorous and interesting manner. A review is not the place for discursive and prolix writing. In writing a review much consideration should be given to the relative importance of the material to be included in order to make full use of the space available. A defect found in many reviews is that of over-emphasis of minor details and inaccuracies to the exclusion of the major contributions made. Where a minor inaccuracy is symptomatic of the whole treatment, it can well be included. But the line between criticism for its own sake and the criticism that looks toward the improvement of the scientific field is a difficult one to draw. Where major deficiencies exist and criticism is merited, reviewers should not hesitate to express themselves vigorously.

Many reviews begin with a general statement of the book's purpose, proceed to a more detailed discussion of the contents, with some emphasis upon its contributions and its weaknesses, and close with an evaluation of its contributions as a whole. Books written by many authors, *i.e.*, collections of articles, present a special problem. In some instances the contents are so well integrated that the book can be treated as a whole; in others, the contents of the sections must be considered separately. In general, *Bulletin* reviewers do not reproduce the table of contents of a book nor present a list of chapters, but confine themselves to a more general treatment of the book by longer sections. *Practice varies widely and should vary with the book reviewed.*

The policy of the *Bulletin* is to review revised editions if substantial changes have been made. In general, such reviews are short and confined largely to the changes made. Although the *Bulletin*, because of lack of space, does not review the many monographs which appear in regular series, an exception is sometimes made when "monograph" is used loosely to cover a publication in book form not in a regular series, or when a monograph in a related field is not readily accessible but important to psychologists.

Occasionally, by editorial arrangement, a special review which is given more space than regular reviews appears. Sometimes such a review is sent to the author of the book reviewed to give him an opportunity for reply. Only, on exceptional occasions, are replies to book reviews printed in the regular book review section published.

A study of the book reviews published from September, 1941, to June, 1942, shows reviews in the *Bulletin* to average 832 words in length, with a mean variation of 304 words, *i.e.* half the reviews fall between 528 words and 1,136 words. Reviews of books in foreign languages, those dealing with history or method or those which present substantial new findings tend to be longer, while reviews of elementary texts and revised editions tend to be shorter.

For style and makeup, the reviewer should consult earlier issues of the *Bulletin*. The *Bulletin* follows the practice of *The Manual of Style* (2). Since reviews are presented as running text, tables and graphs are not usually included. Technical abbreviations such as IQ, CR, EEG, etc., are used rather than the full words. Numbers are always written out when they begin a sentence, and numbers under 10 are written out, except when they occur in series, or accompany the word pages. Designations of sections, parts or chapters of a book, follow the style of the book, *i.e.*, Roman where Roman occurs in the book and Arabic when Arabic occurs. References to pages in books are entered directly in parenthesis without the abbreviation p. or the word page; thus (27), (298).

Copy should be typewritten, *double space*, 27 lines to the page, $6\frac{1}{2}$ inches to the line (65 pica spaces of 75 elite spaces) with one-inch margins right and left and at the top and bottom of the page. Typed in this style, elite type runs 332 ± 19 words per page, pica 257 ± 16 words per page, and *Bulletin* print (9 on 10) 559 ± 32 words per page.

Page equivalents of copy typed in this manner, in terms of *Bulletin* print, are found in the following table.

Words	Elite Typing	Pica Typing	*Bulletin* Print
2,000	6.0	7.2	3.6
1,800	5.4	6.5	3.2
1,600	4.8	5.8	2.9
1,400	4.2	5.0	2.5
1,200	3.6	4.3	2.1
1,000	3.0	3.6	1.8
800	2.4	2.9	1.4
600	1.8	2.2	1.1
400	1.2	1.4	.7
200	.6	.7	.3

The citation at the head of the review follows *Bulletin* practice, as described by McGeoch (1). Following is an example of the manner in which the title should be typewritten (double space) at the beginning of the review:

WOODWORTH, R. S. Experimental psychology.
New York: Henry Holt, 1938. Pp. xi+889.

Note that the name of the author is typed in capitals and that only the first word of the title of the book is capitalized (except when the title itself contains a proper noun). If there is a sub-title, it is included. For joint authorship the names of the authors are typed thus:

WARDEN, C. J., JENKINS, T. N. & WARNER, L. H.

Where there are more than three authors, the senior author's name is given followed by *et al.*; if the book is a collection of articles under an editor, the editor's name is given, followed by (Ed.) in parenthesis as WATSON, G. (Ed.). If the book is a revised edition or a numbered edition, an entry is made in parenthesis after the title, thus: (Ref.) or (2nd Ed.) or (2nd Ed. Rev.). The name of the reviewer appears in capitals at the right of the page at the end of the review, and the name of the institution with which he is connected at the left in lower case underlined, to indicate italics, as in the following example:

JOHN F. DASHIELL.

University of North Carolina.

Ordinarily book reviews are prepared at the request of the editor who sends a copy of the book to a reviewer with an indication

of the space available. When the review is received in the editorial office the copy of the book becomes the personal property of the reviewer. Occasionally, however, reviews are submitted without such a request and are accepted or rejected in accordance with editorial judgment on their timeliness and value. The *Bulletin* is particularly anxious to secure reviews from the younger members of the profession and urges psychologists who are interested in their preparation to correspond with the editor.

Although the editor examines the books that are sent to the *Bulletin* and forms some opinion whether or not they are worthy of review, nevertheless, occasionally upon reading a book, a reviewer decides that it does not deserve space in the *Bulletin*. In this case, a letter giving the reasons should be sent to the editor.

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PSYCHOLOGY AND THE WAR

Edited by

STEUART HENDERSON BRITT

CONTENTS

PERSONNEL RESEARCH IN THE ARMY

V. THE ARMY SPECIALIZED TRAINING PROGRAM

BY STAFF, PERSONNEL RESEARCH SECTION, CLASSIFICATION AND REPLACEMENT BRANCH, THE ADJUTANT GENERAL'S OFFICE

During the period of defense preparation which preceded Pearl Harbor, and since the declaration of war, the Army's need for leaders and technically trained men for officers and specialists steadily increased. There was at first a civilian reservoir of qualified individuals upon which the Service could draw, but in many fields of technical work the need has always exceeded the civilian supply. As the size of our armed forces increased and the manpower shortage became more acute, the Army faced mounting problems in securing trained personnel. The Army's own training program, enormous and complete as it is, is not equipped to provide the necessary types of extensive technical training, or to offer the sort of background courses required to produce potential military engineers or personnel officers. The various plans for the recruiting of college students represented attempts to maintain the flow of highly trained men into the Service. However, with the recent lowering of the draft age to 18, the supply of men from this source has been greatly curtailed.

To meet the problems involved in this situation the Army Specialized Training Program (ASTP) was established. Its purpose is to guarantee the Army the highly trained men it needs for technicians and officers. Eligibility is based upon the ability of an individual to profit from instruction and then, in turn, to render service to the Army. Institutions whose resources are to be utilized will be selected by the Commanding General, Army Service Forces;* contracts with these institutions will be negotiated by the commanding generals of the Service Commands and the Military District of Washington. These commands are geographical divisions of the country.

There is already in existence, of course, a system of Officer Candidate Schools (OCS) from which are graduated commissioned officers. These schools are specialized in accordance with the needs of the branch of the Service to which the graduate officers will be assigned. The majority of men in these Officer Candidate Schools are chosen from the ranks on the basis of performance of

* Formerly Services of Supply.

military duties, test scores, and demonstrated capacity for leadership. It is not feasible, however, in the short time available in the OCS, to offer technical training of the advanced type often required. Nor can it be given on a large scale in other Army training installations.

The administration of the ASTP will be the responsibility of the Army Specialized Training Division, recently created by the War Department. Representatives of the American Council on Education, the United States Office of Education, and various institutions of higher learning throughout the country have collaborated in developing the program, which will be divided into a Basic and an Advanced Phase.

As now constituted, the Basic Phase covers a period of nine months, and includes work in chemistry, English, geography, history, mathematics, and physics. This phase is essentially the same for all men; some differentiation in terms of the advanced curricula does occur in the latter part of the Basic Phase. The Advanced Phase involves specialized training in chemistry, engineering (aeronautical, civil, chemical, electrical, mechanical, metallurgical, and sanitary), mathematics, medicine (including dental and veterinary), modern languages, personnel psychology, and physics. Curricula are set by the Army Specialized Training Division. The Army cannot, of course, grant college credit for work accomplished, but it is hoped and expected that the colleges concerned will elect to do so. The lengths of the various curricula depend upon the field of specialization. The training will be organized on the quarter system, the academic year being divided into four 12-week terms; at the end of each term objective examinations will be given. Men in the program will attend school continuously until they are transferred to other duties.

In planning the program, there were two distinct groups of men to consider. The first includes those men not yet in the Army but who will soon be liable to call, principally the 18- and 19-year-olds, most of whom have not been to college, and those men now in college who have been deferred because of the nature of the studies they are pursuing. The second group includes the large number of older men soon to be called who also will be eligible. This group includes those men now in the Army who are as able to profit from advanced training as those who have not yet been inducted.

In setting up the program, it was important from the Army's point of view that the best men be chosen. For the men

now in the Army, it is equally important that they be given the same opportunity to apply for training as the men not yet in the Service. It is apparent, then, that the ASTP has been set up to enroll men at all stages of specialized training. This means that carefully constructed achievement examinations must be administered to all eligible men to determine exactly where they should be entered in the Basic or Advanced Phase. At the begininng, the program is primarily concerned with selecting qualified men already in the Army. When these are exhausted, the problem will be one of enrolling men entirely from those who are being newly inducted. Selection procedures will thus become simpler as the program advances.

Men participating in the program must have had at least 12 weeks of basic military training; they will be studying as soldiers under military discipline, members of the Army stationed at a college or university. No soldier is eligible for training if he has already been selected to attend Officer Candidate School or if his unit has been alerted for overseas duty. For the Basic Phase, the following additional qualifications are necessary: a man must have had a high school education or its equivalent, must be between 18 and 21 years of age (he must not have reached his 22nd birthday), and must have made scores of 110 or better on both the Army General Classification Test* and the Army Specialized Training Test (discussed below). To be eligible for the Advanced Phase, a man must be 18 years of age or older, must have had one or more years of college, and must have made a score of 110 or better on the Army General Classification Test and 115 or better on the Army Specialized Training test.

Every soldier enrolled under the program in a college or university has the rating of Private, 7th grade, regardless of his rank before entering. Commissioned officers are excluded from applying for the program. Tuition, room, board, books, and incidental fees will be paid for or furnished by the Army. Men will receive the regular pay of Privates, 7th grade, $50 per month.

The selection of qualified men now in Army installations is handled by an Army Specialized Training Program Board (ASTP Board) composed of commissioned officers working closely with the unit personnel officer. In many instances the personnel officer is an active member of the Board.

* The Army General Classification Test, given to all men entering the Army, is a measure of learning ability. Scores of 110 and above include roughly the top 30%.

During the past few months the records of all enlisted men and non-commissioned officers have been checked to identify those eligible for Basic or Advanced ASTP training. All these men will be given the ASTP Test: an educational achievement examination prepared by the Personnel Research Section of the Classification and Replacement Branch, Adjutant General's Office. Those who meet the qualifying score fill out a Personal Data Form for the information of the ASTP Board. For the most part this information is of a factual nature regarding the soldier's personal and educational history, including such points as the number of semester hours completed at the college level in a wide range of subjects and the languages which a soldier reads well, speaks well, or of which he has only a smattering of knowledge. There are also items which request information as to whether the soldier was a farm or city dweller before induction, on his *intended* occupation prior to induction (if he is a student), on the number of grades of school completed by his father and mother, and on the number of brothers and sisters he has. These last items were included to secure data on the democratic character of the selective process.

The soldier is also given opportunity to indicate his preference of courses which he would like to pursue and institutions in which he would like to carry on his studies.

In selecting and assigning men eligible for the Army Specialized Training Program, the ASTP Board will take into consideration the soldier's Army record, his qualifications, his stated preferences, and the needs of the Service. Men who meet the qualifications for the college and university Basic Course are normally assigned without question. Because present policy provides that the participation of qualified non-commissioned officers would mean a reduction in grade and pay, these men may now request that they not be assigned to college study. Privates, Privates First Class, and Technicians may not express such preference. In general, participation in the program is comparable to any other military assignment.

Students who are now in college and who have been deferred as members of the Enlisted Reserve Corps or because they are following an approved course or both, are now liable to call. Those men following approved courses who will graduate before June 30, 1943 will be allowed to graduate, at which time they will be inducted. Those men who will not have graduated by that time

will be allowed to complete the first full semester or corresponding academic period that begins in 1943, after which time they will be inducted. (Men in this group who are members of the Enlisted Reserve Corps will continue on inactive status until that time, when they will be called to active duty.) After the completion of basic military training, those who are qualified will be detailed for further instruction under the Army Specialized Training Program.

Because of the wide variation in the backgrounds of the men to be trained, it is necessary that they be assigned to work at various levels. Thus one soldier may take only the last half of the Basic Phase; another may need only one term's work in the Advanced Phase to fit him for an Army specialty. The same flexibility also exists with regard to the time men are taken out of the ASTP. The time when, and the reason for which, a man is detailed to other duties depend upon his degree of success in the work and the current needs of the Army. A man may be dropped at any time because of failure; in this case he is returned to a unit as a private. At the end of any term in the Basic Phase, he may be sent to an Officer Candidate School, he may be assigned to the next higher ASTP course, or he may be returned to troops. If a soldier completes the Basic Phase, which most of the men assigned to it are expected to do, he may then continue in the Advanced Phase. Flexibility likewise exists as to the assignment of men from the Advanced Phase. At the end of any term a man may be sent to Officer Candidate School or may be made a technical non-commissioned officer. In a few exceptional cases a man may be detailed to further Army technical training, and in very exceptional cases he may be made available for technical work to be done outside the Army but deemed highly important to the war effort.

The training, under the ASTP, of personnel technicians is a relatively small part of the program in terms of numbers of men involved. Of the 150,000 soldiers which the Army expects to have participating each year, about 800 will be detailed to study in this field. These men will pursue their work at one of eight schools (roughly one to each Service Command) chosen not only for their facilities but for their geographic location. It is emphasized that the aim here is not to train psychologists, but personnel technicians, and the curriculum has been weighted with this in mind. Following is a proposed list of courses to be taught during the fourth and fifth terms in the Advanced Phase:

Fourth Term:	Contact Hours per Week	
Subject	*Recitation*	*Laboratory*
Statistics	4	5
Tests and Measurements	4	5
Occupations and Vocational Psychology	4	5
Social Psychology	2	0
	14	15
Fifth Term:		
Work, Fatigue, and Efficiency	4	0
Normal and Abnormal Personality	2	0
Personnel Methods	2	3
Perception and Learning	4	5
Tests and Measurements; Interview Methods	2	7
	14	15

Tests for all ASTP courses, including those in personnel psychology, will be developed by the Personnel Research Section, Classification and Replacement Branch, AGO. As presently planned, there will be both informational and functional tests in this field at the end of each term. For the latter type, a hypothetical problem in military personnel work will be set up, and the student will be asked to suggest satisfactory procedures for resolving it. In the construction of these tests, as well as those for other fields of study, the Personnel Research Section will rely not only on its own staff but on the assistance of those who will teach these courses and on expert consultants who will work either at Washington or in the field.

The Classification and Replacement Branch, chiefly through the Personnel Research Section, plays a considerable role in the Army Specialized Training Program. Its functions are not policy making but are concerned with the selection and personnel aspects of the program. These include: the development, validation, standardization, and publication of all tests for the selection, classification, and disposition of candidates for the Army Specialized Training Program; the development of procedures for the administration, scoring and evaluation of such tests; the development of procedures to be observed by the ASTP Boards; the development of periodic achievement examinations in each subject which, together with the recommendations of the institution, will determine whether a man enrolled in the ASTP should remain therein; the

selection, procurement, training, and disposition of control personnel who will inspect, supervise, and coordinate the testing and selection phase of the program; and the development and operation of administrative procedures for the assignment and movement of men from all procurement sources to all training centers and training units.*

* Since the preparation of this report several minor changes have been made. A major change is the establishment of a STAR Center in each Service Command which functions as a reception center for ASTP personnel, receiving the men, testing them, and allocating them to participating institutions and to proper courses and levels.

THE OFFICE OF PSYCHOLOGICAL PERSONNEL—REPORT FOR THE SECOND SIX MONTHS

BY STEUART HENDERSON BRITT

Executive Director, Office of Psychological Personnel, National Research Council

I. Reports of the Office of Psychological Personnel

A report of the activities carried on by the Office of Psychological Personnel during its first six months of operation—February 1, 1942, to July 31, 1942—has previously been published (7). The present report is a brief summary for the second six months of operation, August 1, 1942, through January 31, 1943. The OPP has continued as a "clearing-house" between individual psychologists and various agencies and organizations. In addition to the usual matters involving job requests, materials for the "Psychology and the War" section of the *Psychological Bulletin*, meetings of psychologists, assistance to individual psychologists, etc., the Executive Director has been actively concerned with certain broader aspects for psychologists. To borrow a phrase used by the Subcommittee on Survey and Planning in Psychology, this has involved *the advancement of psychology as science and profession* (3). Through contacts both in Washington and elsewhere, the attempt has been made to promote sound public relations for psychology (cf. **2**, **3**, **15**).

Detailed accounts for one-month or two-month periods have been sent regularly to the following:

1. Emergency Committee in Psychology
2. Council of the American Psychological Association
3. Board of Governors of the American Association for Applied Psychology
4. Board of Affiliates of the American Association for Applied Psychology
5. Council of the Society for the Psychological Study of Social Issues
6. Council of Directors of the Psychometric Society
7. Officers of Section I (Psychology) of the American Association for the Advancement of Science
8. Board of Directors of the National Council of Women Psychologists
9. Officers of Department of Psychology of the American Teachers Association
10. Officers and Directors of the Psychological Corporation
11. Officers of the National Institute of Psychology
12. Subcommittee on the Listing of Personnel in Psychology
13. Chairmen of Subcommittees of the Emergency Committee in Psychology

14. Chairmen of Committees of the Division of Anthropology and Psychology of the National Research Council
15. Medical Director and Secretary of the Division of Personnel of the National Committee for Mental Hygiene

II. Continuation of the Office

At the annual meeting of the American Psychological Association, September 3, 1942, it was voted that "the Association appropriate $10,000 for the support of the Office of Psychological Personnel . . . and that an additional sum of $2,680 be appropriated to be used, if, in the judgment of the Council of Directors such additional expenditures should prove desirable" (**14**, p. 727). The American Association for Applied Psychology, at its annual meeting on September 4, 1942, voted an appropriation of $1,000 as its contribution toward the support of the Office of Psychological Personnel for 1943 (**13**, p. 16). As an indication of interest in the work of the Office, the Council of the Society for the Psychological Study of Social Issues also voted to make a contribution to the Office of Psychological Personnel of $25. The OPP has continued to be housed in the building of the National Academy of Sciences at 2101 Constitution Avenue, Washington, D. C., through the generous cooperation of the officers of the National Research Council. Space has been provided by the Division of Anthropology and Psychology of the National Research Council.

The OPP is fortunate in having representatives of the Emergency Committee in Psychology, the American Psychological Association, and the American Association for Applied Psychology as official Consultants to the Office: Dr. Robert M. Yerkes, member of the Emergency Committee in Psychology; Dr. Willard C. Olson, Secretary of the American Psychological Association; and Dr. Alice I. Bryan, Executive Secretary of the American Association for Applied Psychology. These three Consultants have given counsel and advice to the Executive Director of the Office of Psychological Personnel. In December, 1942, Miss Iris Stevenson, formerly psychologist at the Wayne County Training School, Northville, Michigan, was appointed secretary and assistant to the Executive Director of the OPP.

Existing contacts between the office of Psychological Personnel and the "Clearing House of Placement of the Eastern Psychological Association" have been strengthened. Dr. Theodora M. Abel, Chairman of the Clearing House, has referred certain requests to the OPP, which in turn has submitted the names of certain psychologists to the Clearing House.

At the September meeting of the American Psychological Association it was voted that the Committee on Displaced Foreign Psychologists "be requested to turn over its functions as rapidly as practicable to the Office of Psychological Personnel" (**14**, p. 723). Dr. Barbara S. Burks, as Chairman, has proposed that the Committee circularize the foreign psychologists with whom contacts have been maintained, to determine their present locations; and that, following this circularization, their records be transferred to the Office of Psychological Personnel.

III. Relationships with Various Federal Agencies

Cooperative relationships continue to be maintained with various Federal agencies. The wide variety of inquiries regarding the functions of the OPP and the numerous requests for names of psychologists available for employment on specific projects provide tangible evidence that the work of the Office is becoming more widely known. The Executive Director has endeavored to follow up every special matter that comes to his attention.

1. *Office of the Adjutant General, War Department.* The Office of Psychological Personnel has continued to notify the War Department of the qualifications of men with psychological training immediately preceding their induction into the Army. Under present procedures it is believed that practically every man with psychological training is "spotted" at his Reception Center. The services of the OPP have also been utilized by some men with psychological training in the armed services who have felt that greater use should be made of their professional skills. The OPP has also assisted the Classification and Replacement Branch of The Adjutant General's Office in locating certain specialized personnel.

2. *Psychological Division, Office of the Air Surgeon, Headquarters Army Air Forces.* Contacts have been continued with various officers in the Army Air Forces.

3. *Army Air Forces Technical Training Command.* Some of the psychological activities of the Army Air Forces Technical Training Command have been described by Faubion and Bellows (**10**). Liaison relations have been continued with this branch of the service.

4. *Surgeon General's Office.* A recent article by Layman (**11**) describes the work of the clinical psychologists assigned to general hospitals of the Army.

5. *Women's Branches of the Armed Service.* Information has been obtained regarding opportunities for psychological service within the Women's Army Auxiliary Corps (WAAC), Women Appointed for Volunteer Emergency Service (WAVES), the Women's Auxiliary of the Coast Guard (SPARS), and the women's reserve of the Marine Corps (**18**). Contacts have been actively promoted by the Subcommittee on the Services of Women Psychologists in the Emergency, especially by Dr. Ruth S. Tolman, Chairman of the Subcommittee. A brief statement

regarding women psychologists in the WAVES, SPARS, and Marine Corps is given by Bremner (4).

6. *Army Specialist Corps.* During the latter part of 1942 the Army Specialist Corps was discontinued, but prior to that date the Office of Psychological Personnel continued to assist various psychologists on questions relating to this branch of the armed service. A report on the Army Specialist Corps has been published by Baier (1).

7. *Navy Department.* Continuing contacts have been maintained with a great many officers in several different branches of the Navy Department. Most of this work is of a highly confidential nature and cannot be published.

A note by Louttit (12) gives some indication of the extent of the activities being carried on by psychologist officers of the United States Naval Reserve.

8. *Selective Service System.* In Selective Service Occupational Bulletin No. 10, issued June 18, 1942, psychology was one of a list of "critical occupations" (8). The profession of psychology continued to be listed in the revision of this Bulletin, published on December 14, 1942 (17).*

Detailed information has been published in the *Psychological Bulletin* regarding the occupational deferment of psychologists and psychologists in training (5).

9. *Other Federal Agencies.* Day-to-day contacts, personal visits, luncheons, conferences, etc., have been continued with representatives of various other Federal agencies. The War Manpower Commission, the United States Maritime Commission, and those offices concerned with the special training program of the colleges and universities, should be specifically mentioned.

It is significant that, of approximately 4,000 men and women psychologists in the country, well over 1,000 are now in the armed services or employed as civilians in full-time war work (16).

IV. Project Carried on at the National Roster of Scientific and Specialized Personnel

The activities previously reported (6; 7, p. 782) continue to be carried on at the National Roster of Scientific and Specialized Personnel.

V. Contacts With Other Professional Societies

As described in the report for the first six months (7, pp. 782–3), liaison relations have been continued with official representatives of several other professional groups.

VI. Requests for Psychologists

A list is given in the previous published report (7, pp. 783–6) of 57 specific requests for psychologists during the first six months of

* Psychology was not included, however, in Occupational Bulletins 10 and 11, as amended March 1, 1943. (See *Psychol. Bull.* 1940, **43**, 380.)

operation of the OPP. During the second six months, an additional 104 requests were received, as listed below. Following the usual practice of the Office, unless a request was specifically limited to men psychologists or women psychologists, the names of *both men and women* were supplied in each instance.

58. Instructor for a State university. Salary $2,200 to $2,600.
59. Six additional names for commissions in the Army Specialist Corps.
60. Assistant Professor at a State university. Salary $2,500 to $3,200.
61. Man instructor at a women's college. Salary $1,800 to $2,000.
62. Social psychologist with a knowledge of the British Empire, for a government agency.
63. Psychologist with a knowledge of the Russian language, for a Government agency.
64. Confidential request for a psychologist in the field of vision.
65. Instructor at a State university. Salary $3,200.
66. Volunteer women psychologists for Council of Intercultural Relations.
67. Men psychologists for a branch of the armed services.
68. Psychologists for test construction work in the Marine Corps. Salary range $2,000 to $5,600.
69. Clinical psychologists for two penal institutions.
70. Psychologist with a sociological background for Government agency. Salary $2,000 to $3,600.
71. Industrial psychologist for a confidential project.
72. Assistant to the chairman of a research committee. Salary $3,000.
73. Psychologists with statistical training. Salary $2,300 to $2,600.
74. Psychologists for project on attitudes toward venereal disease. Salary $4,000.
75. Instructor at a State university.
76. Psychologist familiar with problems of transportation. Salary $3,600.
77. Three clinical psychologists for a State public welfare service. Salary $150 a month.
78. Instructor at a University.
79. Instructor at a University.
80. Experimental psychologist for a Government agency. Salary $4,600.
81. Instructor at a State university.
82. Women psychologists for internship at a State training school. Salary $1,800.
83. Men and women with psychological training for work as coders. Salaries $1,620 to $2,000.
84. Psychologist for a transportation company. Salary $150 a month.
85. Woman assistant for a research group. Salary $3,000.
86. Women psychologists to assist in preparing questionnaires. Salary $2,000 to $2,300.
87. Psychologist to serve as a Junior Analyst for Government Agency. Salary $3,200.
88. Psychologists to assist in a testing program for an industrial concern.
89. Psychologists with statistical training for a Government agency. Salaries $2,600 to $3,200.

90. Psychologists with knowledge of vision and fatigue. Salaries $3,600 to $4,200.

91. Psychologists at different levels, some with language skills, for a Government agency.

92. Woman psychologist with special qualifications to set up a Government project. Salary $4,600.

93. Substitute instructor at a University.

94. Two outstanding psychologists to head divisions of a new department in a University.

95. Psychologists in experimental field available to work with special research group.

96. Men psychologists with special qualifications to aid in test construction for a Government agency.

97. (See Item No. 88). Further request as to qualifications of some women psychologists.

98. Request from a State university for the names of available psychologists with particular training.

99. Request from an industrial concern for psychologists to work on a research project.

100. Men psychologists with particular qualifications for a project with the U. S. Maritime Commission.

101. Recent graduates in psychology as Assistant Personnel Technicians. Salaries $2,000 to $2,400.

102. Experimental psychologist in the field of vision. Salary $3,800.

103. Psychologists with certain qualifications, in the Army at least four months, and over 30 years of age.

104. Clinical psychologist unusually well trained, with hospital experience. Salary $3,800.

105. Social psychologist with a knowledge of statistics. Salary $4,600.

106. Young psychologist trained in elementary statistics and test construction, for special project.

107. Names of psychologists in the Army, to gather source material for a special publication.

108. Man psychologist for a position with a Government agency. Additional names for a "contact" position with this agency.

109. Men with wide training and experience in the social sciences, for work with a Government agency. Salary $5,600.

110. Psychologist trained in the field of propaganda, who would be available for a series of university lectures.

111. Psychologists trained in the field of physiological and experimental psychology, for work with a branch of the armed services.

112. Psychologists available for consultation on the problem of emotional shock.

113. Psychologist for a position in a University, with special training in the field of physiological psychology.

114. Man trained in physiological psychology, for a University teaching position.

115. Women for employment in various positions in State institutions.

116. Woman to fill a position as psychologist in a State Training School.

117. Psychologist with experience in test construction and a knowledge of Chinese.

118. Psychologists for a Government agency, available to work on some problems of regionalism. Salary $3,200.

119. Persons available at the P-2, P-3, and P-4 level for interviewing work for a Government agency.

120. Two psychologists for employment as Unit Chiefs in a Government agency. Salary $4,600.

121. Women psychologists with statistical training for work on a special project.

122. Woman psychologist for editing of manuscripts and bibliographical work. Salary $2,500.

123. Psychologist to serve as substitute instructor at a University. Salary $2,000.

124. Women qualified to recruit, train, and supervise interviewers for a polling project.

125. Vocational psychologist available for a temporary appointment on a project for the Navy.

126. Names of enlisted men in the Navy, with psychological and statistical training.

127. Psychologists with knowledge of test construction and radio and electricity, for work with a Government agency.

128. Research work of a confidential nature, for a Government agency.

129. Names of enlisted men in the Army, with psychological and statistical training.

130. Men trained in personnel procedures available for commissions in a branch of the service.

131. (See Item No. 100). Follow-up request for additional names in connection with a project of the U. S. Maritime Commission.

132. Psychologist with engineering background, for a branch of the service.

133. Persons available for a year's internship in a State institution.

134. Persons available for a year's internship in another State institution.

135. Teacher of clinical psychology in a University. Salary $1,800 to $2,600.

136. Woman to organize a Department of Clinical Psychology in a small college. Salary, $1,800 to $2,000.

137. Teacher of clinical psychology in a University. Salary $3,305.

138. Teacher of clinical psychology in a University.

139. Woman psychologist to supervise field workers.

140. Psychologists, geographically distributed throughout the United States, to act as interviewers in a public opinion polling project.

141. Psychologists with training and experience in test construction, for work with a branch of the armed services.

142. Psychologists for work of a confidential nature, for a Government agency.

143. Psychologists trained in personnel, for work with a branch of the armed services. Salaries $2,900 to $4,100.

144. Men with industrial engineering training or experience to work with a branch of the armed services.

145. Negro psychologist for interviewing, for a Government agency.

146. Men clinical psychologists for work in a State institution.

147. Personnel analysts of various grades, to deal with placement problems in a branch of the armed services. Salaries $2,600 to $4,600.

148. Clinical psychologists and statisticians for work with a branch of the armed services.

149. Psychologist trained in personnel work, for a Government agency. Salary $3,200 to $3,800.

150. Psychologists with statistical training for work with the War Department. Salaries $2,300 to $2,600.

151. Psychologist, and also psychological examiner, for a child guidance center.

152. Woman with undergraduate training in experimental psychology and physics, for work with a branch of the armed services. Salary $1,440.

153. Psychologist for administrative post in a branch of the armed services.

154. Psychologist trained in statistics, for work with a Government agency.

155. Men psychologists to teach in a special training program.

156. Psychologist for special work with War Department. Salary $3,800.

157. Men psychologists with experimental background, to work on confidential research projects.

158. Psychologist with experience in film production, for work with a branch of the armed services.

159. Clinical psychologists (one man, one woman), for a Juvenile Court. Salaries $1,900 to $2,100.

160. Woman psychologist for teaching position in a college.

161. Clinical psychologist for staff of a School of Medicine.

For the reasons stated in the previous published report, it is extremely difficult to give a complete accounting of the total number of psychologists actually placed: "(1) not all organizations have 'followed through' by indicating who was finally appointed; (2) in very few cases have the psychologists concerned communicated with the OPP when they received offers or were newly employed; (3) in certain instances psychologists whose names have been submitted to agencies have turned down offers of employment without notifying the OPP" (7, p. 786). It is definitely known, however, that a substantial proportion of psychologists have become engaged in new activities in psychology as a result of the efforts of the Office of Psychological Personnel. First, many psychologists who have registered with the OPP have had their qualifications presented to the agencies and organizations listed above and thus have received direct offers. Second, many individuals have asked for specific suggestions and in several cases have found openings due to information supplied by the OPP.

It should be emphasized that *the placement services of the Office of Psychological Personnel are not its only function.* Important though this work is, the OPP has also been concerned with public relations for the psychological profession.

VII. "Psychology and the War" Section of the Psychological Bulletin

As Editor of the "Psychology and the War" section of the *Psychological Bulletin*, the Executive Director of the OPP has at-

tempted to keep psychologists advised of changing conditions and current trends. Letters received indicate that these materials have been of value to the profession, especially to many of the younger psychologists who are most affected by war conditions.

VIII. Meetings Sponsored by the Office of Psychological Personnel

The OPP has continued to sponsor meetings of psychologists at Science Service, 1719 "N" Street N.W., to discuss topics of current interest. The programs for August through January were as follows:

August 11: Dr. Theodore M. Newcomb, review of "Civilian Morale," Goodwin Watson, Editor (Houghton-Mifflin, 1942).

October 6: J. Stephen Stock, statistician, U. S. Department of Agriculture, "The National Sample for Public Opinion Measurement."

October 20: Dr. Eugene L. Horowitz, "Democracy for Negroes."

November 3: Two Negro leaders, Truman K. Gibson, Jr., Assistant to the Civilian Aid, Office of the Secretary of War, and Mrs. Thelma Tabb, Employee Services Officer of the Office for Emergency Management; discussion of problems of the Negro in the armed forces and in civilian life.

November 17: Dr. Robert M. Yerkes, Yale University, "The Professionalization of Psychology."

December 1: Dr. John W. Gardner, Foreign Broadcast Intelligence Service, Federal Communications Commission, "The Level of Aspiration."

December 15: Major Henry Beaumont, Adjutant General's Office, War Department, "The Special Training Program in the Army."

January 12: First Lieutenant James W. Layman, Walter Reed Hospital, "The Function of the Clinical Psychologist in the Neuropsychiatric Unit of the General Hospital."

January 26: Dr. Saul B. Sells, Principal Statistician of the Statistical Standards Office, Office of Price Administration, "The Development of Questionnaires, Forms, and Surveys in a Civilian War Agency."

IX. Speeches by the Executive Director

On November 18, 1942, the Executive Director of the OPP spoke to several hundred students at the College of the City of New York on the work of psychologists in the war effort. On November 25, he addressed students of psychology at Brooklyn College.

An excerpt from the radio broadcast on "Psychologists in the War Effort" (9) of July 11, 1942, was reproduced by the Columbia Broadcasting System in the October, 1942, edition of *Talks*, quarterly digest of addresses presented in the public interest by the Columbia network.

X. Summary of Office Activities

An over-all picture of the quantity of work handled by the Office of Psychological Personnel during the first six months of operation is given in a table published in the previous report (7, p. 792). The following table gives this type of information for the second six months:

OFFICE ACTIVITIES

August 1, 1942, to January 31, 1943

	Number
Incoming	
Letters, telegrams, registration forms, etc.	2,342
Outgoing	
Letters, telegrams, questionnaires, follow-up cards, etc.	2,537*
Incoming telephone calls directly concerned with jobs, Selective Service status, registration, and appointments	829
Office callers on official business	285
Special conferences outside the office	126

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* This figure does not include checking files, compilation, and preparation of 104 different lists containing hundreds of names, each selected for certain specified qualifications.

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RECOMMENDATIONS BY THE EMERGENCY COMMITTEE IN PSYCHOLOGY ON THE OCCUPATIONAL DEFERMENT OF PSYCHOLOGISTS

For many months the Emergency Committee in Psychology has been seriously concerned with the complex problem of the occupational deferment of psychologists. Subcommittees have studied the problem, and others related to it, and have been responsible for getting psychology included in the Army Specialized Training Program. Regulations issued by the National Headquarters of the Selective Service System to State Directors and Local Boards have, until recently, included psychology as a basis for the occupational deferment of undergraduate students and graduate assistants, but at present psychology is not so listed. Teachers of psychology and professional psychologists in non-academic service have never been so included.

The purpose of the Emergency Committee in making recommendations in his area is primarily to promote the winning of the war, rather than the advancement of psychology as such. At its meeting on March 26–27, 1943, the Emergency Committee

VOTED:

(1) That the Emergency Committee *not* recommend the blanket deferment of undergraduate students in psychology, since the largest single need for personnel technicians and junior psychologists is in the Army, since the present undergraduate students in psychology constitute the largest single source of men for Army use as personnel technicians, and since these personnel technicians can be more quickly and adequately trained under the Army Specialized Training Program than under the traditional undergraduate curriculum in psychology.

(2) That the Emergency Committee recommend that a graduate or post-graduate student in psychology should be considered for occupational classification if, in addition to pursuing his graduate studies, he is also acting as a graduate assistant in a recognized college or university. A graduate assistant should be a student who, in addition to pursuing such further studies, is engaged in one of the following: (1) in scientific research certified by a recognized federal agency as related to the war effort, or (2) in classroom or laboratory instruction in psychology for not less than 12 hours per week.

(3) That the Emergency Committee recommend the occupational classification of psychologists who are training students in any of the Army or Navy Specialized Training Programs.

QUESTIONNAIRE CONTROL IN A CIVILIAN WAR AGENCY

BY SAUL B. SELLS
Statistical Standards Office, Office of Price Administration

Price control and rationing require information for planning and for control. Planning activities include the determination of maximum prices and the development of rationing programs. Control activities include administration and enforcement of existing programs. Determinations of maximum prices must be made with due consideration of many factors, including customary business practices, price, cost and profit trends, regional variations and individual differences in prices and profit margins, increased costs and changes in supply and demand. Rationing plans must be adapted to established industry organization and distribution channels. There must be accurate data on supply and demand, government and civilian requirements and needs, transportation and storage facilities, and numerous other factors.

Administration of price control involves reporting of price and financial information, procedures for price adjustment and protest, and surveys to measure compliance, to evaluate price and profit trends, and to make necessary adjustments. Certain supplementary procedures of licensing, registration, and other reporting are sometimes employed. Administration of rationing involves regular reporting of production and distribution inventories, registration of producers, distributors and consumers, circulation and accounting of ration currency, and procedures for adjustment of inventories and allotments.

Enforcement of price control and rationing programs requires a certain amount of statistical reporting, and includes investigations and compliance surveys. Questionnaires, reporting forms, and statistical surveys are the instruments for securing the necessary data for planning and for control. The Office of Price Administration has made administrative provision for the development and control of such reporting forms in order to secure maximum efficiency in their use with a minimum burden upon industry and the public.

The Statistical Standards Office of the Office of Price Administration is responsible for giving technical advice to operating departments in report and survey planning and for reviewing and approving or disapproving all public reporting forms to be sent to ten or more respondents. The Statistical Standards Office evalu-

ates every proposed public reporting form with respect to (a) its adequacy to provide the needed information; (b) the burden upon the respondent; (c) its relationship to other reports submitted by the respondent to OPA and other Federal agencies; (d) simplicity and understandability to the respondent; (e) statistical adequacy of plans for sampling, tabulation, and analysis; and (f) administrative provision of personnel and facilities for using, filing, and maintaining the collected information.

Further control is secured under the Federal Reports Act of 1942, under which public reporting forms and plans of all Federal agencies are required to be approved by the Bureau of the Budget. Duplication of reports of Federal agencies is eliminated in the review by the Budget Bureau. The Statistical Standards Office, upon its approval of public reporting forms, clears them with the Budget Bureau.

The Statistical Standards Office has adapted many procedures of psychometrics and market research to the development of public reporting forms. Objective questions, questionnaire format, graded vocabularies (particularly in forms designed for consumers), pretests of items, forms and instructions are regularly used. Periodic re-examination is made of recurrent forms with reference to the quality of the returns, the experience and recommendations of personnel at Local Boards, field offices and in Washington, and to the experience of respondents. Preliminary discussion of questionnaires with representatives of industry and of trade associations is frequently useful in adapting forms to the language and record keeping conventions of particular groups and in securing their cooperation in filing returns.

To develop standards for improved practice, the Statistical Standards Office makes studies of completed surveys with respect to specific reporting problems. A detailed formulation of criteria for public reporting forms has been developed and is being expanded as rapidly as possible. These criteria relate to form design, methods of collecting information, statistical procedures and administrative procedures. Most OPA surveys of price problems are based upon relatively small samples. As a basis for sampling analysis, the Statistical Standards Office compiles source data, based upon Census reports, reports of other Federal agencies, and previous surveys.

The percentage of returns to mail questionnaires is unusually high, often exceeding 80 per cent. An exception may be cited, however, in the case of mail-accounting surveys. In one study of

appropriate methods for collection of information, a recommendation was made with respect to inquiries seeking unit cost information that such investigations should be made only by personal visit of trained accountants, and only after detailed uniform instructions are provided. The findings of this study indicate that sometimes as few as 10 per cent of such returns are received, as a result of restrictions of available records and complexity of accounting analysis. Surveys at wholesale and retail levels, and financial studies of accounting data, are made regularly by personal vists. The resources of the Regional Offices and of other agencies are usually employed for field studies.

The planning and review staff of the Statistical Standards Office includes fourteen analysts and a section chief. The Civil Service classification adopted for analysts is "Economic Statisticians." Of the present staff, three members are trained psychologists; two, sociologists; one, a mathematical statistician, and the remainder social or economic statisticians. The general nature of the problem and many of the specific skills called for have demonstrated the need for persons with psychometric and social-psychological training. Although the activities of public reporting, form planning, and design are currently carried on primarily by social and economic statisticians, there are increasing opportunities in this field of work for psychologists.

PSYCHOLOGICAL ASPECTS OF REHABILITATION

BY ROGER G. BARKER

Stanford University

The task of rehabilitating physically disabled persons has been greatly increased in its scope and its urgency by the war. The extent to which psychological problems are met in this work is indicated by the following listing of activities in which various classifications of rehabilitation workers engage:

Restoring motor functioning after neural lesion, muscular atrophy, and joint ankylosis.
Measuring progress of motor restoration.
Re-educating motor abilities after amputation and paralysis.
Motivating patients to accept treatment and training, and to cooperate in making it most effective.
Preventing patients from becoming emotionally dependent upon treatment, therapist, or institution.
Detecting and coping with malingering.
Administering painful treatment.
Overcoming fear of diagnostic and treatment procedures.
Administering bedside mental hygiene; individual morale.
Planning and administering occupational therapy programs.
Organizing and administering wards and institutions for optimal social adjustment of patients; group morale.
Aiding personal adjustment to permanent disabilities and to changed roles in military or civilian life.
Vocational and educational counselling.
Working with persons having special types of disabilities, e.g., the blind, the deaf, cardiac cases.
Providing vocational and academic education.
Selecting rehabilitation personnel.

From this it would appear that any expansion of the rehabilitation services of private and government agencies to the point where additional personnel are needed will require courses of instruction in the psychological aspects of rehabilitation for several classes of workers. There are likewise technical psychologists required in any expanded rehabilitation program who would benefit by special training in the particular psychological problems of the invalided and disabled.

A considerable amount of material from physiological and experimental psychology, abnormal and clinical psychology, child and educational psychology, and industrial psychology is relevant to problems of rehabilitation. However, much of it requires interpretation and application to specific rehabilitation problems before it is of much value to rehabilitation workers. At Stanford Univer-

sity a course in psychology for rehabilitation workers has recently been offered, a topical outline of which is herewith presented. Inasmuch as this particular course was arranged especially for physical therapists, occupational therapists, and nurses, the sections on motor learning, motivation and adjustment, and mental hygiene were emphasized. Psychiatric problems have been avoided.

TOPICAL OUTLINE OF COURSE IN PSYCHOLOGY FOR REHABILITATION WORKERS

I. *Physiological psychology of motor functions*
   A. Techniques and limits of restoring function in cases of peripheral and central neural lesions, and muscular lesions
II. *Psychology of motor learning*
   A. Optimal procedures for making and breaking motor habits
   B. Measurement of motor learning
III. *Motivation and adjustment in the therapeutic situation*
   A. Psychological factors in the treatment situation which aid and which impede medical therapy
      1. Effect of emotionality upon autonomic and voluntary systems
      2. Sources of emotionality in treatment situations
      3. Retraining and readjustment procedures; desirable and undesirable adjustments to treatment
   B. Motivating procedures in the treatment situation
      1. Importance of the larger personal meaning of treatment to the patients
   C. Psychological factors increasing and decreasing sensitivity to pain and discomfort
IV. *Mental hygiene of the hospitalized person*
   A. Unique aspects of the hospital situation
      1. Isolation
      2. Prepotency of internal stimuli
      3. Dependence upon decisions and motor functions of others
   B. Behavioral resultants of unique psychological situation
      1. Regressive behavior: egocentricity, dependence, limited interests
   C. Mental hygiene procedures
      1. Desirable and undesirable occupational and recreational procedures
      2. Desirable and undesirable institutional routines and organization
      3. Group activities in wards
      4. Extramural contacts
      5. Roles of staff members
         a. Problem of emotional dependence
         b. Function of the interview
         c. Techniques of interviewing
   D. Social psychology of institutional morale

V. Problems of adjustment to permanent disability and to changed role in military and civilian life
- A. Psychological situation of the disabled in our culture
- B. Advantageous and disadvantageous adjustments to disability
- C. Attitudes and behavior of family and acquaintances
- D. Psychotherapeutic indications and techniques

VI. Special problems met in the vocational and educational guidance and psychometry of disabled persons

VII. Psychology of special disabilities

Our experience with this course has pointed to the need for a bibliography of the pertinent psychological literature; and, if the demand warrants, for a manual of psychology for rehabilitation workers; for demonstration and training centers for the application of psychology to rehabilitation problems; and for fundamental research upon the adjustment problems of the physically disabled.

BOOK REVIEWS

DE SILVA, HARRY R. Why we have automobile accidents. New York: John Wiley, 1942. Pp. xvii + 394.

The problem of controlling automobile accidents in the United States is one worthy of the research efforts of our best scientists, technicians, and public leaders. Dr. De Silva has assisted in the eventual solution of the problem not only by his individual research on specific points but perhaps even more by his formulation and analysis of the problem as a whole. The magnitude of the problem is reflected in annual casualty lists which can only be compared with those of our major wars, while the losses in property damage and impaired production of both civilian and war programs is measured in millions of dollars and valuable time. In contrast with the importance of the problem to practically every citizen, our efforts in accident prevention have been piecemeal and largely ineffective. Isolated groups such as commercial fleet operators and individual cities and states have shown that it is possible to make vast improvements at costs which are well within reason, yet most other groups have continued with little or merely temporary improvement.

De Silva points out that our strong but often irrational insistence on individual rights of citizens to be drivers is an influence which often negates safety movements. We tend to suppress the unpleasant facts or to attack superficial causes. Another factor in the continuation of inadequate public response is the complexity of the problem. Even the professional reader will probably be surprised to find how difficult it is to secure reliable statistics on accidents so that the influence of various factors can be estimated in planning a safety program. Automobile transportation is so basic to personal, social and business affairs that it is not surprising to find that analysis of the rule of any single factor is extremely difficult. For example, the significance of highway curves may be confused with that of the location of roadhouses producing drunken drivers, while the creation of super highways which remove many hazards of ordinary driving may lead to such an increase in driving speeds as to increase accident rates. Dealing with single variables has usually produced only temporary improvements or face-saving evasions of the issue.

Until we have centralized reporting of automobile statistics it will be necessary to seek out localities in which significant factors have been varied in attempts to control accidents and then put together a composite estimate. However, even if we had centralized handling of statistics the problems of experimental and statistical design of studies, e.g., analysis of variance, are as fascinating as they are important. In place of current criterion measures such as the standard of "fatalities per vehicle mile" De Silva suggests as indices either fatal and personal injury accidents per vehicle mile or all fatal and non-fatal accidents per vehicle mile.

In evaluating the bases underlying individual differences in accident rates De Silva reviews the evidence for four main groups of factors: (1) exposure, in terms of distances driven under various geographical, climatic, temporal and other traffic conditions; (2) speed; (3) skill; and (4) safety mindedness, a composite of attitudes, skills and information. In the re-

lated problem of measuring the relative accident rates of cities or states the interplay of various factors such as proportions of urban and rural areas, economic, educational, geographic, climatic, and other factors are so complex that comparisons on any simple bases such as number of accidents per year for each driver would be greatly misleading. Marked shifts in the safety ranking of states occur as successive additional factors are taken into account.

In evaluating the roles of improved automobiles and highways it is apparent that desirable as they are, these alone are inadequate to solve the whole problem of automobile accidents because of the numerous human factors such as poor attitudes and skills of drivers, and the carelessness of pedestrians, who are a major factor in accidents. Furthermore, highway improvement is markedly limited as a method of accident control because of its much greater costs in comparison with vehicle, driver and pedestrian factors.

Best practices in training, examining, licensing, and later controlling drivers are reviewed. Training will probably have to become a part of our public school work, but in the meantime must be supplemented by other civic agencies for adults in addition to private agencies. Through licensing examinations there is an operational check on the end result of whatever kind of training is provided and this can be made very effective in eliminating poor drivers but follow up enforcement is necessary to continue its benefits. On account of the practice of admitting all drivers who were experienced at the time the licensing laws went into effect, about 60% of all present drivers have never taken a real driver's examination. The usefulness of driver clinics and other positive motivating devices to supplement merely negative (punishment) programs is indicated. Lack of continuity in office among state vehicle administrators may partially nullify a good license law, as will the lack of adequate training, consistent support and adequate working conditions for the examiners and patrolmen. Civil service provisions now cover only a small portion of examiners, thus inviting political abuses.

In the opinion of the reviewer Dr. De Silva has rendered a major service in giving an understandable picture of the importance of automobile accidents, their underlying factors, and the relative effectiveness of the various plans which have been developed to care for each aspect of the problem. He has also shown the importance of interrelations between factors and the necessity for a national organization for the supervision and integration of automobile accident reporting, analysis, and safety planning. Any civic leader or public official concerned with the problems of automobile accident prevention will find in this book a very helpful analysis of each of the major problems involved, together with an evaluation of the ways in which the various possible remedial measures have worked out in practice.

All too many efforts of applied psychologists have been concerned almost exclusively with the application of experimental and statistical methods to a specific practical situation. Useful and necessary as this is, it frequently fails to be as helpful as it might be if it had been preceded by more thorough analysis of all the major factors in the situation, and followed by a synthesis of all the major lines of evidence into the best avail-

able plan of action. Teachers of applied psychology may find this book a useful illustration of such a methodology as well as a summary of the latest knowlege in its special field.

ROBERT H. SEASHORE.

Northwestern University.

LEWINSON, THEA STEIN and ZUBIN, JOSEPH. Handwriting Analysis. New York: King's Crown Press, 1942. Pp. xiii + 147.

According to a statement by its proponents, graphology has recently become increasingly important as a tool of psychology. Although this art is much used in Europe, according to the statement, it is regarded in America with skepticism because of the obviously subjective character of the ratings upon which the graphologists depend. This book is an attempt to replace the subjective bases by means of a set of objective scales. These scales are offered in the hope that they will stimulate the scientific study of problems heretofore studied intuitively.

Handwriting is regarded as a highly individual form of behavior, expressive of the total personality pattern, which is to be approached through consideration of the type of movement which produces the specimen. A basic hypothesis in this approach is that these movements vary individually from very contracted or controlled movements to those very much released. In order to be legible, handwriting must be controlled, but too much control means a cramped style. Balance is regarded as the midpoint of the scale, indicative of a strong, rhythmic movement.

The approach is analytic. Each of twenty-two details is to be rated according to a carefully prepared scale, where plus three is extreme contraction, zero is rhythmic balance, and minus three is extreme release. The details considered include those grouped under four main components namely: *form*, which deals with the general appearance and shape of letters, ornamentation, etc.; the *vertical aspect*, which includes such things as the height of various parts of letters, the distance between lines, etc.; the *horizontal component*, which includes such things as space between letters and words, slant, etc.; and finally the *depth component*, which deals with pressure, cursiveness, etc. The treatment of details of handwriting is thorough, entirely reasonable, and at times tedious.

The explanation of the method of using the scale is clear-cut. It is accompanied by specific suggestions as to statistical procedures which may be useful in testing various hypotheses. Some results are given from the study of five normal and fifteen insane subjects, showing that the handwriting of the normal in some respects approximates rhythmic balance, while that of the insane exhibits significant and interesting deviations from such balance.

This book may be regarded as a manual for a set of objective scales. Judging it as one does a newly-published test and manual, one notes that the standardization is extremely tentative, the scale-making procedure is competent, and the idea behind it is a set of hypotheses which constitutes the basis for graphology. The weakest point in the whole approach appears to be the basic postulate, namely that "if a person's handwriting is characterized by balance between contraction and release, his personality too is rhythmically balanced and consequently well adjusted." In the

judgment of the reviewer, this postulate is contrary to all the tendencies of research findings concerning personality, in that research on personality fails to show any close integration which would permit diagnosis of personality type from study of any one limited aspect of behavior.

The graphological system of Klages and Pulver, presented in chapter nine of this book, appears absurd and mystical, at least insofar as its application to normal subjects is concerned. One may therefore be grateful for the construction of a set of objective scales for use in testing theories which might otherwise be defended by evasion and general vagueness. The scales herein provided are probably both reliable and objective to a degree satisfactory for the purposes in mind; their validity is yet to be established.

H. D. CARTER.

University of California.

INBAU, FRED E. Lie detection and criminal interrogation. Baltimore: Williams and Wilkins, 1942. Pp. vii+142.

This is a technical manual in an applied field. It is technical in the sense that it deals soundly and carefully with a professional subject. It is applied in that it accepts the phenomena in question (the bodily manifestations of emotions) and makes no attempt to investigate their fundamental causes and relationships, merely discussing their application in the practical situation of lie detection. The experimental psychologist will be disappointed in that it contains no analysis of the intricacies of the physiological processes which are being utilized. He will be pleased, however, to find that the book is conservatively written and deals briefly but adequately with such over-enthusiasts as Dr. Marston and the late Rev. Walter G. Summers.

The book is divided into two sections. The first deals with lie detector technique and concludes with an interesting chapter on its legal aspects. The second section discusses criminal interrogation. This is handled on a purely clinical and empirical level but is none the less interesting and stimulating. Its applications are much broader than the mere field of criminal interrogation and can be helpful to anyone working in the general field of interviewing. This reviewer has found much in it which is applicable to psychiatric interviewing in selecting naval recruits where many of the volunteers attempt to conceal disqualifying defects in order to join the Navy. This section ends with a discussion of the legal aspects of criminal interrogation.

The book is well written and has been given an adequate index and format.

WILLIAM A. HUNT.

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NOTES AND NEWS

JAMES BURT MINER, head of the department of psychology, University of Kentucky, died, March 24, at the age of sixty-nine years. Dr. Miner had served as instructor in psychology (1903–04), University of Illinois; instructor (1904–05) and assistant professor of philosophy (1905–06), the State University of Iowa; assistant professor of psychology (1906–15), University of Minnesota; assistant professor (1915–18) and associate professor of psychology (1918–21), Carnegie Institute of Technology; professor of psychology and head of the department (since 1921) and director of the personnel bureau (since 1930), University of Kentucky.

LILLIEN JANE MARTIN, professor emeritus of psychology, Stanford University, died, March 26, at the age of ninety-one years. Dr. Martin began her teaching career at the Indianapolis High School (1880) as a teacher of science. She served as vice-principal and head of the department of science, Girls' High School, San Francisco (1889–94), and assistant professor (1899–1909), associate professor (1909–11), and professor of psychology (1911–16), Stanford University. From 1916 until a week before her death, Dr. Martin had served as psychopathologist and chief of the mental-hygiene clinic at the San Francisco Polyclinic and Mt. Zion Hospital.

CHRISTIAN H. STOELTING, president of C. H. Stoelting and Company, Chicago, and a former president of the Scientific Apparatus Makers of America, died on March 18 at the age of seventy-eight years.

The Officers and Directors of the Massachusetts Society of Clinical Psychologists passed the following resolution on the death of Dr. ELIZABETH EVANS LORD, on January 10th. "Dr. ELIZABETH EVANS LORD contributed to the advancement of the profession of clinical psychology through her skilful collaboration with members of related professions, teachers, nurses, social workers, and physicians, and through her competence and integrity in psychological diagnosis and research. She was one of the founders of the Massachusetts Society of Clinical Psychologists, and as its second president, and subsequently as a member of the Board of Directors, ably served the interests of the Society, giving generously not only of her wisdom but of her friendliness, warmth, and humor. She will be remembered as an admired colleague and a beloved friend."

HERBERT WOODROW, professor of psychology at the University of Illinois, has been elected vice-president and chairman of Section I, Psychology, of the American Association for the Advancement of Science.

HAROLD E. BURTT, professor of psychology at Ohio State University, has been elected section committeeman for Section I, Psychology, of the American Association for the Advancement of Science for a four-year term, expiring in 1947.

On March 4–6 the Inter-Society Color Council, of which the American Psychological Association is a member body, held its annual meeting conjointly with the Optical Society of America at the Hotel Pennsylvania in New York. The subject of vision predominated at these meetings. A symposium of four invited papers on Vision was presented to the Optical Society. One paper was given by HARRY HELSON, a member of the APA on "Some Factors and Implications of Color Constancy." The ISCC arranged a symposium of eight invited papers on Color Blindness and Color Blind Tests. The APA was represented on this program by DR. ELSIE MURRAY with "The Evolution of Color Vision Tests," and by FORREST LEE DIMMICK with "Methodology of Test Preparation." The two symposia will be published together in the *Journal of the Optical Society of America* and reprints will be available through the Inter-Society Color Council. Among the contributed papers presented to the Optical Society were two for which SIDNEY M. NEWHALL was jointly responsible, "A Psychological Color Solid," and "Final Report on the Spacing of the Munsell Colors."

An announcement has been made of the award of two Westinghouse-Science Grand Scholarships of $2,400, and of eight Westinghouse-Science Scholarships of $400 each, and of 30 one-year scholarships of $100 each, to selected graduating seniors in high schools as a result of the second annual Science Talent Search conducted annually by the Science Clubs of America, and sponsored by Science Service and the Westinghouse Electric and Manufacturing Company. The aptitude examination, which was given to 15,000 students as one of the bases of selection, was designed by HAROLD A. EDGERTON and STEUART HENDERSON BRITT, who, with DR. HARLOW SHAPLEY of Harvard College Observatory, constituted the committee on the scholarship awards.

CLAUDE M. DILLINGER has succeeded RICHARD WILKINSON, now on leave of absence, as associate professor of psychology, Southwest Missouri State Teachers College, Springfield.

ELMER KINSEY KILMER has been appointed professor of psychology, Muhlenberg College, Allentown, Pa.

DR. GERTRUDE RAND has been appointed Research Associate in Ophthalmology on the Knapp Foundation, College of Physicians and Surgeons, Columbia University. Her office is in the Institute of Ophthalmology of the Presbyterian Hospital, 635 West 165th Street, New York City.

MARGARET G. MCKIM is now instructor in the psychological and biological foundations of education, Teachers College, Columbia University.

In addition to $10,000 appropriated by the APA and $1,000 supplied by the AAAP, the Society for the Psychological Study of Social Issues

has sent in $25 and the Society of Experimental Psychologists, $100 for the support of the Office of Psychological Personnel.

The Western Psychological Association will hold three sub-regional meetings this June, in place of its regular meeting. Since there will be no election, the officers of last year will continue to serve until the next general meeting. The sub-regional meetings planned are as follows: *1. Northwest.* Meetings at Oregon State College, Corvallis, in conjunction with the Pacific Coast AAAS, June 14–19. O. R. CHAMBERS, local chairman. *2. Bay Area.* Meetings at the University of California, Berkeley, June 12. E. C. TOLMAN, local chairman. *3. Los Angeles Area.* Meetings at the University of Southern California, Los Angeles, June 12. FLOYD RUCH, local chairman. It is hoped that psychologists in the armed services who are in these regions will participate in the meetings.

An appointment commencing in September as half-time Research Assistant in Psychology at $600 for ten months with tuition waived is available at the University of Illinois. The position is made possible by an American Medical Association grant for research upon appetite, food preference and dietary habit in the rat. The work will be supervised by PROFESSOR PAUL THOMAS YOUNG, Urbana, Illinois, to whom applications should go.

In a reorganization just announced, the Department of Experimental Biology at the American Museum of Natural History is changed to the Department of Animal Behavior. The scientific staff of the department is: DR. FRANK A. BEACH, Chairman and Curator; Dr. T. C. SCHNEIRLA, Associate Curator; MR. LESTER R. ARONSON, DR. ALBERT P. BLAIR, Assistant Curators; MISS A. MARIE HOLZ, Scientific Assistant; DR. LIBBIE H. HYMAN, DR. WILLIAM ETKIN, DR. CHARLES M. BREDER, JR., Research Associates. The two-fold function of the department is the conduct of research and the planning of exhibits. The research program, using both field and laboratory methods seeks the general principles revealed in the behavior of various animal groups. Current studies include work on invertebrates, fishes, amphibians, birds, and mammals. At present much research centers on reproductive behavior, with assistance from the NRC Committee for Research in Problems of Sex. Plans for exhibits designed to illustrate broad principles of animal behavior, and to emphasize the evolution of major reaction patterns have been approved. Such exhibits are conceived as enriching the visitor's understanding of the psychological aspects of animal life and increasing his perspective and understanding of human behavior.